IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexamination of:	)	
	)	
U.S. Patent No. 9,906,067	)	Control No.: *To be assigned*
	)	
Issue Date: Feb. 27, 2018	)	Group Art Unit: *To be assigned*
	)	
Inventors: Paul Garrity and Aaron Jungreis	)	Examiner: *To be assigned*
	)	
Appl. No. 14/754,863	)	Confirmation No.: *To be assigned*
	)	
Filing Date: Jun. 30, 2015	)	
	)	
For: APPARATUS, SYSTEM AND METHOD TO WIRELESSLY CHARGE/DISCHARGE A BATTERY	)))	

Mail Stop *Ex Parte* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

<u>REQUEST FOR *EX PARTE* REEXAMINATION OF U.S. PATENT NO. 9,906,067</u>

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Ex. IPR-5	IPR2021-00389 – Petitioner's Request for Rehearing

I. Introduction

An *ex parte* reexamination is requested on claims 1, 7-12, and 15-17 ("the challenged claims") of U.S. Patent No. 9,906,067 that issued on February 27, 2018 ("the '067 patent," Ex. PAT-A), for which the U.S. Patent and Trademark Office ("Office") files identify Garrity Power Services, LLC ("Garrity") as the assignee. In accordance with 37 C.F.R. § 1.510(b)(6), Requester Samsung Electronics Co., Ltd. ("Requester") hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) and 35 U.S.C. § 325(e)(1) do not prohibit it from filing this *ex parte* reexamination request.

This request raises substantial new questions of patentability based on prior art that the Office did not have before it or did not fully consider during the prosecution of the '067 patent, and which discloses the features recited in the challenged claims.[1] The Office should find the claims unpatentable over this art.

On August 17, 2020, Patent Owner asserted infringement of the '067 patent in *Garrity Power Services LLC v. Samsung Electronics Co., Ltd. et al*, Case No. 2-20-cv-00269 (E.D. Tex.). Requester respectfully urges that this Request be granted and that reexamination be conducted with "special dispatch" pursuant to 35 U.S.C. § 305.

In accordance with 37 C.F.R. § 1.20(c), the fee for *ex parte* reexamination (non-streamlined) is submitted herewith. If this fee is missing or defective, please charge the fee as well as any additional fees that may be required to Deposit Account No. 50-2613.

II. Identification of Claims and Citation of Prior Art Presented

Requester respectfully requests reexamination of claims 1, 7-12, and 15-17 of the '067 patent in view of the following prior art references, which are also listed on the attached PTO Form SB/08 (Ex. PA-SB08).

Ex. PA-1	U.S. Patent No. 6,301,128 to *Jang et al.* ("*Jang*")

[1] One *inter partes* review petition, *Samsung Electronics Co., Ltd. v. Garrity Power Services, LLC*, IPR2021-000389 (filed December 31, 2020), challenged claims 1-3, 5, 7-8, 10-11, and 15-16 of the '067 patent based on prior art not presented in this Request (with the exception of Jeong (Ex. PA-9), which was a secondary reference for a single ground challenging dependent claims 7, 10, 11, and 16 in the IPR petition, but the Board did not consider that ground). (Ex. IPR-1.) The Patent Trial and Appeal Board denied institution on July 22, 2021. (Ex. IPR-3.) Samsung filed a request for rehearing of that institution decision, which is currently pending. (Ex. IPR-5.)

Ex. PA-2	U.S. Patent No. 6,028,413 to Brockmann ("*Brockmann*")
Ex. PA-3	U.S. Patent No. 8,242,754 to Yang ("*Yang*")
Ex. PA-4	U.S. Pre-Grant Publication No. 2013/0314038 to Kardolus *et al.* ("*Kardolus*")
Ex. PA-5	U.S. Patent No. 8,363,427 to Anguelov *et al.* ("*Anguelov*")
Ex. PA-6	U.S. Patent No. 4,720,667 to Lee *et al.* ("*Lee*")
Ex. PA-9	Korean Intellectual Property Office published patent 10-2014-0121200 ("*Jeong*") with Certified English Translation
Ex. PA-11	A Bidirectional Inductive Power Interface for Electric Vehicles in V2G Systems ("*Madawala*")
Ex. PA-12	U.S. Patent No. 6,057,668 to Chao ("*Chao*")
Ex. PA-13	U.S. Patent No. 9,912,174 to Soar ("*Soar*")

A copy of each of the above-listed references is attached to this request pursuant to 37 C.F.R. § 1.510(b)(3). A copy of the '067 patent is also attached to this request as Exhibit PAT-A pursuant to 37 C.F.R. § 1.510(b)(4).

III. Overview of the '067 Patent

A. Specification and Drawings of the '067 Patent

The '067 patent relates to "wireless power transmission and, more specifically, to an apparatus, system, and method to wirelessly charge and/or discharge a battery." (Ex. PAT-A, 1:6-10; *see also id.*, Abstract ("An apparatus, system and method to wirelessly charge and/or discharge a battery").)

The '067 patent states that "[i]n recent years, wireless power systems have been developed that allow recharging of the batteries without making a physical connection between the battery and the charger" through "resonant operation to transfer power" where the "battery itself is electrically/metallically tied to the load it will eventually power and charging is accomplished through a metallically isolated wireless interface." (*Id.*, 1:29-36.) According to the '067 patent "standard wireless interfaces [are] set up to allow transfer of power in only one direction" and "[t]here are many advantages associated with a battery that can be wirelessly charged or discharged . . . over a metallically isolated path for both charging and discharging." (*Id.*, 1:39-40, 1:57-60.)

Figure 1 of the '067 patent "illustrates a block diagram of an embodiment of a power system with a wireless battery interface and a wireless battery." (*Id.*, 2:34-36.) According to the '067 patent, the system includes "a wireless battery interface 120 and a wireless battery 130," "power source/load 110 such as a utility grid power source," and "wireless battery 130 is docked into the wireless battery interface 120 by a coupler" that "links a magnetic field 140 induced by a metallic coil (or winding) 150 surrounding a wireless battery interface magnetic core piecepart in the wireless battery interface 120 with a wireless battery magnetic core piecepart in the wireless battery 130." (*Id.*, 4:57-67.) The wireless power transfer block diagram of Figure 1 of the '067 patent is shown below:

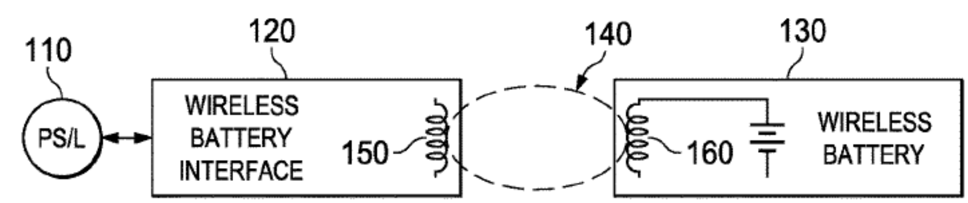


FIG. 1

(*Id.*, FIG. 1.)

To charge the wireless battery 130, "a voltage is induced in a metallic coil (or winding) 160 surrounding the wireless battery magnetic core piecepart in the wireless battery 120 by a voltage impressed across the terminals of the metallic coil 150 that surrounds the wireless battery interface magnetic core piecepart in the wireless battery interface 120," and to discharge the wireless battery 130, "a voltage is induced in the metallic coil (or winding) 150 surrounding the wireless battery interface magnetic core piecepart in the wireless battery interface 120 by a voltage impressed across the terminals of the metallic coil 160 that surrounds the wireless battery magnetic core piecepart in the wireless battery 130." (*Id.*, 4:67-5:13.) The '067 patent further states with respect to Figure 1 that "[t]he power source/load 110 can be, for instance, a utility grid power source that is employed to charge the wireless battery 130, and also can be arranged to absorb energy from the wireless battery 130 for utility grid power source load-leveling purposes." (*Id.*, 5:13-17.)

Figure 2 of the ’067 patent is “a schematic diagram of an embodiment of a power system with a wireless battery 200 and a wireless battery interface 250.” (*Id.*, 5:20-22, FIG. 2.)

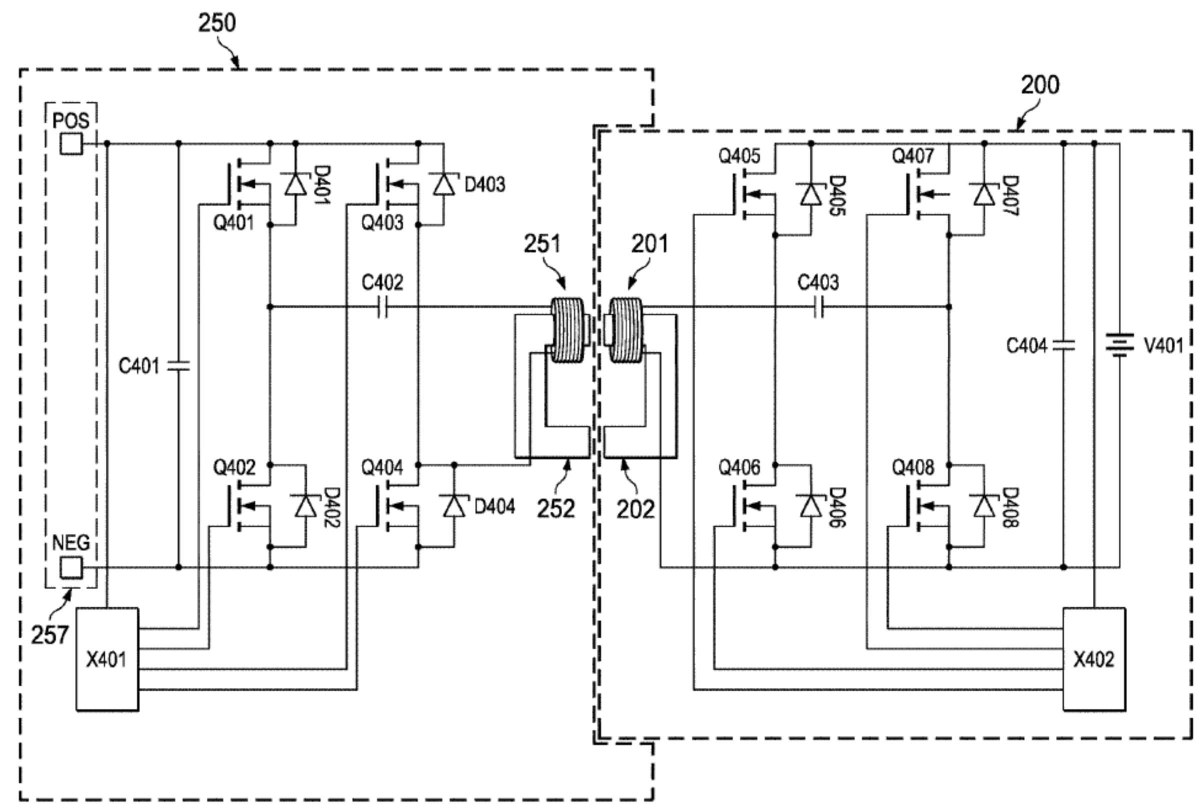


FIG. 2

(*Id.*, FIG. 2.)

According to the ’067 patent, “wireless battery 200 is formed with a metallic coil 201 surrounding a wireless battery magnetic core piecepart 202 that can be used to both transmit and receive power,” and “wireless battery interface 250 is formed with a metallic coil 251 surrounding a wireless battery interface magnetic core piecepart 252 that can be used to both transmit and receive power.” (*Id.*, 5:22-25, 5:56-58, FIG. 2.) Additionally, “[t]here is a small air gap in the magnetic path created by the magnetic core pieceparts 202, 252.” (*Id.*, 5:64-65, FIG. 2.) As Figure 2 of the ’067 patent shows, each metallic coil, 201 and 251, is coupled to a full-bridge power train comprising power switches Q405-408: “The metallic coil 201 is coupled to a resonant capacitor C403 and a full-bridge power train is formed with power switches (e.g., metal-oxide semiconductor field-effect transistors (‘MOSFETs’)) Q405, Q406, Q407, Q408 and diodes D405, D406, D407, D408,” and “metallic coil 251 is coupled to a resonant capacitor C402 and a full-bridge power train is formed with power switches Q401, Q402, Q403, Q404 and diodes D401, D402, D403, D404." (*Id.*, 5:30-34, 6:12-15.)

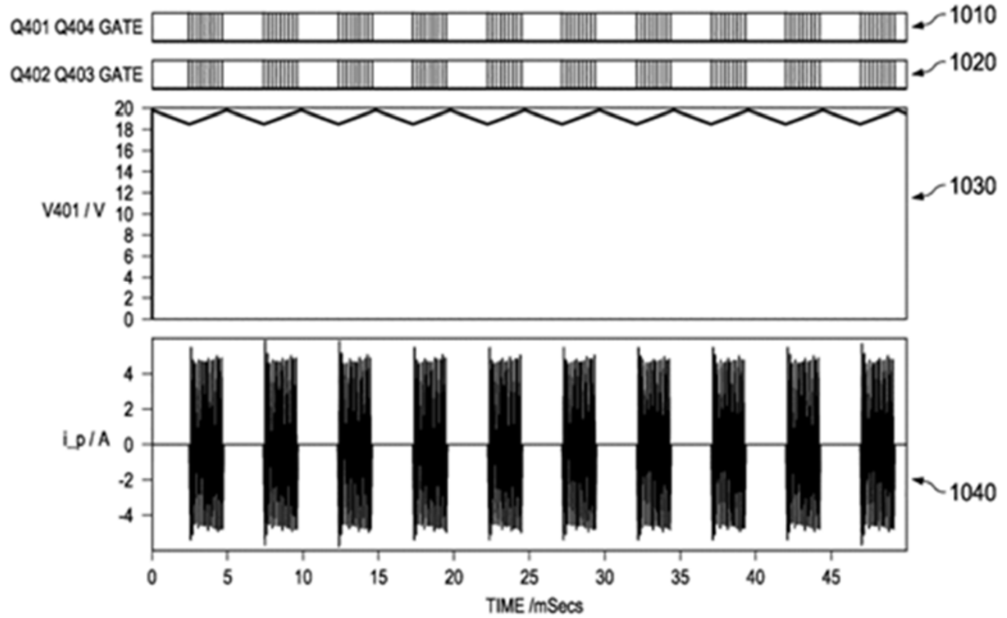
The operation of Figure 2 is as follows:

> If transmitting power from the terminals 257 to the battery V401, the full-bridge power train formed with the power switches Q401, Q402, Q403, Q404 produces a pulsed voltage waveform to the resonant capacitor C402 and the metallic coil 251. The full-bridge power train is switched so that the power switches Q401, Q404 are simultaneously turned on and off with a duty cycle slightly less than about 50 percent (such as 45 to 49 percent). Also, the power switches Q402, Q403 are simultaneously turned on and off with a duty cycle slightly less than 50 percent and 180 degrees out-of-phase with respect to the power switches Q401, Q404. The duty cycle of each power switch is slightly less than 50 percent to decrease a possibility of simultaneous conduction with an opposing power switch and to allow enough time for a magnetizing current in the metallic coil 251 to resonate with the parasitic capacitance of the power switches Q401, Q402, Q403, Q404 to commutate a voltage thereacross. This process results in soft-switching, meaning the voltage across or the current through each power switch Q401, Q402, Q403, Q404 is naturally resonated to substantially zero just prior to turning that respective power switch on or off.

(*Id.*, 6:54-7:8.) Additionally, the '067 patent discloses that "[a] controller (e.g., a controller X401 of the power system of FIG. 2) of the apparatus may be configured to selectively cause at least a portion of the power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level." (*Id.*, 17:34-38.)

Further, the '067 patent discloses how the power system "may be intermittently operated in a burst mode of operation." (*Id.*, 17:23.) Figure 10 represents the periodic nature of the burst mode, in which switches are turned on and off at a particular "switching frequency." (*Id.*, FIG. 10, 14:9-13.)

FIG. 10



(*Id.*, FIG. 10.) As shown in Figure 10 of the '067 patent, the switches Q401-Q404 are operated quickly in short successive bursts of approximately 2 or 3 milliseconds to control the voltage V401 of the battery during charging or discharging. (*Id.*) "The battery voltage V410 increases when the wireless battery interface full-bridge power train is operating and decreases when the wireless battery interface full-bridge power train is off." (*Id.* at 14:1-4.)

The interface "operates in a burst mode" when needed to "regulate the output voltage." (*Id.*, 11:17.) In the context of the '067 patent, a burst mode of operation is a mode that regulates the output voltage of a switching circuit by operating in bursts (e.g., by periodically activating and deactivating) during charging or discharging. (*Id.*, 11:17-19 ("To regulate the output voltage, the wireless battery interface 251 operates in a burst mode of operation.") 17:22-25 ("The power train may be intermittently operated in a burst mode of operation to control a characteristic (such as the voltage V401 illustrated in FIG. 10) of the battery.").)

Finally, the '067 patent describes a purported advantage of the alleged invention as "allowing power flow into or out of the wireless battery 200 to instantly switch direction with no change to the gate drive signals (or duty cycle thereof) of the full-bridge power trains." (*Id.*, 9:57-60.) This advantage permits the system to "behave[] like an actual battery in its ability to both charge and discharge through the same two terminals without any significant change to its voltage level." (*Id.*, 9:66-10:2; *see also id.* at 10:20-32 (describing further advantages of instantly switching power flow direction).) The specification explains the practical applications of such a feature "would include using the battery V401 for load leveling of a utility grid or using the battery V401 to provide peak load demands." (*Id.*, 10:11-19.)

B. Claims of the '067 Patent

The '067 patent includes twenty claims total. (Ex. PAT-A, 18:27-20:32.) The independent claims of the patent recite devices or methods that charge a battery through a transformer formed with magnetic core pieceparts and metallic coils. (*Id.*) For example, independent claim 1, among other claim features, recites "a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer." (*Id.*, 18:29-33.) Further, a battery may "be charged and discharged through an electrically isolating path of said transformer." (*Id.*, 15:20-38.) Similarly, independent claim 15 recites a system of a "wireless battery interface" and a "wireless battery" in which "a wireless battery magnetic core piecepart [is] configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer," such that a battery may be "charged and discharged through an electrically isolating path of said transformer." (*Id.*, 19:20-32.)

The dependent claims of the '067 patent specify a power train and its modes of operation, various switching circuits, a burst mode of operation, and the use of signals with duty cycles to control the operation of charging and discharging. (*Id.*, 18:56-20:32.)

C. Patent Prosecution History of the '067 Patent

The originally filed claims were amended to include additional structural limitations to overcome the art of record. (Ex. PAT-B.) Specifically, during prosecution, the Patent Examiner cited prior art in which a coil surrounds a magnetic core to reject the originally filed claims. (*Id.*, 106.) In addressing claim 1, the Examiner reasoned that the prior art disclosed "a removable first magnetic core piecepart having a surrounding first metallic coil" and a "second magnetic core piecepart having a surrounding second metallic coil" as claimed because the prior art coils wound around a magnetic core to form a transformer. (*See id.*, 106.) For similar reasons, the Patent Examiner noted that the charging device prior art disclosed "a first metallic coil surrounding said wireless battery magnetic core piecepart" as originally recited in claim 15. (*Id.*, 109-11.) The examiner suggested narrowing the claim term to specify "how the coil is surrounded on the magnetic core." (*Id.*, 89). In response, the independent claims were amended such that each magnetic core piecepart has a "metallic coil encircling at least a portion thereof" rather than being "surround[ed]" by the coil. (*Id.*, 92-94.) Thereafter, the '067 patent issued. (*Id.*, 13.)

The references forming substantial new questions of patentability—*Jang*, *Brockmann*, *Yang*, *Kardolus*, *Lee*, *Jeong*, *Madawala*, *Chao*, *Soar*, and *Anguelov*—were not cited or considered during prosecution of the '067 patent. (Ex. PAT-A, Cover; Ex. PAT-B.) Likewise, the references were not cited in any grounds considered by the Board the IPR petition for the '067 patent. (Ex. IPR-1.)

D. Effective Priority Date of Claims 1, 7-12, and 15-17 of the '067 Patent

For purposes of this reexamination only, Requester assumes that claims 1, 7-12, and 15-17 of the '067 patent are entitled to the June 30, 2015 filing date listed on the cover of the '067 patent. (Ex. PAT-A, Cover.)

Jang issued on October 9, 2001; *Brockmann* issued on February 22, 2000; *Yang* issued on August 14, 2012; *Kardolus* published on November 28, 2013; *Lee* issued on January 19, 1988; *Jeong* published on October 15, 2014; *Chao* issued on May 2, 2000; and *Anguelov* issued January 29, 2013. Thus, *Jang*, *Brockmann*, *Yang*, *Kardolus*, *Lee*, *Jeong*, *Chao*, and *Anguelov* qualify as prior art at least under AIA 35 U.S.C. § 102(a)(1).

Soar issued on March 6, 2018 from Application No. 14/890,269 (International Application No. PCT/CA2014/000423) effectively filed May 12, 2014. Thus, *Soar* qualifies as prior art at least under AIA 35 U.S.C. § 102(a)(2).

Madawala is an IEEE publication that was publicly available to persons interested and skilled in the art before June 30, 2015. The Board has routinely held and even taken official notice that IEEE publications like *Madawala* are printed publications. *Power Integrations, Inc., v. Semiconductor Components Industries, LLC*, IPR2018- 00377, Paper No. 10 at 10 (July 17, 2018) (quoting *Ericsson, Inc. v. Intellectual Ventures I LLC*, IPR2014-00527, Paper 41 at 11 (May 18, 2015)). Indeed, in *Ericsson*, the Board "accept[ed] the publication information on the IEEE copyright line on page 1 of [the IEEE reference] as evidence of its date of publication and public accessibility." *Ericsson*, IPR2014-00527, Paper 41, 10-11; *see also Coriant (USA) Inc. v. Oyster Optics, LLC*, IPR2018-00258, Paper 13 at 11 (June 6, 2018); *Microsoft Corp. v. Bradium Techs. LLC*, IPR2016-00449, Paper 9 at 13 (PTAB July 27, 2016) (noting generally that "IEEE publications, such as the one in which Reddy appeared, are distributed widely and intended to be accessible to the public"). Here, *Madawala* bears the markings "OCTOBER 2011" (Ex. PA-11, 4789) and "IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 58, NO. 10, OCTOBER 2011" (*id.*, 4790, 4792, 4794, 4796). Additionally, *Madawala* bears the marking "© 2011 IEEE" on the IEEE copyright line on page 1 of the reference. (*Id.*, 4789.) Thus, *Madawala* qualifies as prior art at least under AIA 35 U.S.C. § 102(a)(1).

IV. *Inter Partes* Review Petition of the '067 Patent

Samsung filed a petition requesting *inter partes* review of claims 1-3, 5, 7, 8, 10, 11, 15, and 16 of the '067 patent. (Ex. IPR-1.) The Patent Trial and Appeal Board (PTAB) concluded there was not a reasonable likelihood that Samsung would have prevailed in establishing the unpatentability of at least one claim of the '067 patent based on the primary reference of *Kasar* (US 10,404,089). (Ex. IPR-3, 2.) The PTAB declined to institute *inter partes* review. (*Id.*)

The PTAB adopted a construction for the term magnetic core piecepart under the narrower *Phillips* standard. The PTAB construed "magnetic core piecepart" as "a magnetic part that cooperates with at least one other magnetic part to create a flux path that passes through the first and second metallic coils." (*Id.*, 13-14.) Applying this construction to *Kasar*, the Board found that there was insufficient evidence that *Kasar*'s permanent magnets created the flux path required by the construction. (*Id.*, 14-15.)

The Board's analysis was limited to the *Kasar* reference and did not consider any of the obviousness combinations put forth by Samsung in this reexamination request (nor did it consider claim construction under the broadest reasonable interpretation claim construction standard, which is applicable here). (*See id.*, 14-17.) Shortly after the Board's institution decision, in a related district court proceeding, the United States District Court for the Eastern District of Texas ("District Court") adopted a construction of "magnetic core piecepart" to mean "core piece that is made of magnetic material." (Ex. EDTX-2, 8-19.) Samsung has requested rehearing of the Board's institution decision supported, among other things, by the analysis contained in the District Court's claim construction order. (Ex. IPR-5.) That rehearing request remains pending.

V. Claim Construction

"During patent examination, the pending claims must be 'given their broadest reasonable interpretation consistent with the specification.'" MPEP § 2111; *see also* MPEP § 2258. The standard of claim interpretation in reexamination is different than that used by the courts in patent litigation. MPEP § 2258; *In re Rambus, Inc.*, 753 F.3d 1253, 1255 (Fed. Cir. 2014) ("Claims are generally given their 'broadest reasonable interpretation' consistent with the specification during reexamination."); *SkyHawke Techs., LLC v. Deca Int'l Corp.*, 828 F.3d 1373, 1376 (Fed. Cir. 2016) (noting that district courts apply the "standard of claim construction as explored in *Phillips v. AWH Corp.*" rather than the "broadest reasonable construction"). Therefore, any claim interpretations submitted or implied herein for the purpose of this reexamination do not necessarily correspond to the appropriate construction under the legal standards mandated in litigation. MPEP § 2686.04; *see also In re Zletz*, 893 F.2d 319, 322 (Fed. Cir. 1989).

For the purposes of this reexamination, the term "magnetic core piecepart" should be construed to mean "core piece that is made of magnetic material" as adopted by the District Court. For example, the '067 patent discloses a "third magnetic core piecepart 1130 hav[ing] a relative magnetic permeability between a relative magnetic permeability of air and the first magnetic core piecepart 1110." (Ex. PAT-A, 14:46-49; *see id.*, 17:38-44.) The District Court correctly relied on this passage, among other evidence, to conclude that "[b]y disclosing magnetic core pieceparts that can have a relative magnetic permeability nearly as low as that of air, the claims and the specification contemplate that a magnetic core piecepart does not necessarily significantly enhance the magnetic flux through a transformer." (Ex. EDTX-2, 13.) The District Court further noted that the designation of the magnetic core piecepart as being the "third" was of no consequence. (Ex. EDTX-2, 13 ("*Free Motion Fitness, Inc. v. Cybex Int'l, Inc.*, 423 F.3d 1343, 1348 (Fed. Cir. 2005) ('[t]he use of the terms "first" and "second" is a common patent-law convention to distinguish between repeated instances of an element or limitation') (quoting *3M Innovative Props. Co. v. Avery Dennison Corp.*, 350 F.3d 1365, 1371 (Fed. Cir. 2003)).")

The Board construed "magnetic core piecepart" as "a magnetic part that cooperates with at least one other magnetic part to create a flux path that passes through the first and second metallic coils." (Ex. IPR-3, 13-14.) The narrowness of this construction was unwarranted, as demonstrated by the District Court's analysis and explained in Samsung's currently pending Request for Rehearing. (Ex. IPR-5.) At a minimum, the narrow construction offered by PTAB does not align with the broadest reasonable interpretation claim construction standard that govern this proceeding, at least because a broader reading than the Board's is reasonable, as demonstrated by the District Court's construction. *See In re Bigio*, 381 F.3d 1320, 1324 (Fed. Cir. 2004) (explaining that the broader claim construction standard used in this proceeding provides the opportunity and responsibility to remove any ambiguity in claim term meaning). Moreover, in adopting its construction, the Board did not have the benefit of a fully developed record including briefing, evidence, and arguments from both parties as in the District Court. Thus, the Board's reading and construction of the term "magnetic core piecepart" is unduly narrow and should not be adopted under the broadest reasonable interpretation standard.

Given how closely the prior art maps to the claims, Requester submits that no construction is required for the remaining terms because the claims would be unpatentable under any reasonable construction of the terms. (Ex. PA-DEC, ¶43.) However, because the claim term "burst mode" has been construed by the District Court to mean "a mode of operation wherein the power train is periodically activated and deactivated" (Ex. EDTX-2, 29), if the Examiner finds that a construction is required, such a construction should be at least as broad as the one adopted under the *Phillips* claim construction standard. *See Facebook, Inc. v. Pragmatus AV, L.L.C.*, 582 F. App'x 864, 869 (Fed. Cir. 2014) (nonprecedential) ("The broadest reasonable interpretation of a claim term may be the same as or broader than the construction of a term under the *Phillips* standard. But it cannot be narrower."); Ex. EDTX-2 (Claim Construction Memorandum and Order for the '067 patent); *see also PPC Broadband, Inc. v. Corning Optical Commc'ns RF, LLC*, 815 F.3d 734, 740 (Fed. Cir. 2016); *In re Zletz*, 893 F.2d 319, 321 (Fed. Cir. 1989) ("During patent examination the pending claims must be interpreted as broadly as their terms reasonably allow.").

Moreover, the District Court's construction of "burst mode" is not necessary in this proceeding because the term was construed merely to aid a jury in understanding a term of art by reducing it to a plain-English description. (Ex. EDTX-3, 17-22; Ex. EDTX-2, 29 ("[T]he Court finds that construing this term will assist the finder of fact.").) But such a term of art would be readily understood by a person of ordinary skill in the art ("POSITA") and a skilled Examiner.

Patent Owner also made several representations about the scope of its claims in the pending District Court litigation. Although the Requester does not necessarily agree with the Patent Owner's construction positions, the Requester submits that the Patent Owner's statements are informative regarding how broadly Patent Owner views the scope of its claims, and thus how the prior art cited in this Request reads on the claims. *See Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1351 (Fed. Cir. 2001) (quoting *Sterner Lighting, Inc. v. Allied Elec. Supply, Inc.*, 431 F.2d 539, 544 (5th Cir. 1970)) ("A patent may not, like a 'nose of wax,' be twisted one way to avoid anticipation and another to find infringement."). For example, the Patent Owner urged that a "burst" includes no more than a burst of power. (EDTX-4, 29 ("In the context of the '067 patent, directed to 'wireless power transmission,' a 'burst' is simply a burst of power.").) Indeed, the Patent Owner suggested that prior art that discloses a burst of power on either side of a transformer would read on claim 9 in this proceeding. (*Id.*, ("The ***power train*** is configured to be intermittently operated in a burst mode [i.e., to transmit or receive bursts of power] of operation to control a characteristic of said battery."); *id.*, 29, 31-33 (explaining that a burst can occur using various switches and different components on either side of a wireless power transformer to satisfy the limitation).)

For claim 12, Patent Owner contends that it requires no more than charging or discharging a battery at the same duty cycle. (Ex. EDTX-5, 28.) According to the Patent Owner, the "original claim language ("configured to enable [charging and discharging] without changing . . .") is easily understood by a POSA as meaning, that **the duty cycle is the same, or does not change, when the battery is either being charged <u>or</u> discharged**." (*Id.* (emphasis added).) Indeed, Patent Owner stressed that these charging and discharging operations can be separated with intervening low-power states, shut down operations, etc. and, accordingly, need not be performed directly after each other, despite the claim language that they are "successively" performed. (Ex. EDTX-6, 8 ("The '067 Patent also describes an example of operation under claim 12 at col. 10, ll. 8-20 (describing providing power during peak demand and receiving). That exemplar embodiment does not mention a prohibition on shutting down or going into a low-power state such as if the battery was full and the grid was below capacity. Indeed, claim 12 is a 'comprising' claim thus and additional steps like shutting down or entering a low power state will not take an infringer out the ambit of infringement.").) While such permissive readings do not comport with the *Phillips* standard, Requester submits that the broadest reasonable interpretation standard counsels in favor of reading the claims for reexamination at least as broadly as Patent Owner. *In re Bigio*, 381 F.3d 1320, 1324 (Fed. Cir. 2004); *see Amazon.com*, 239 F.3d at 1351.

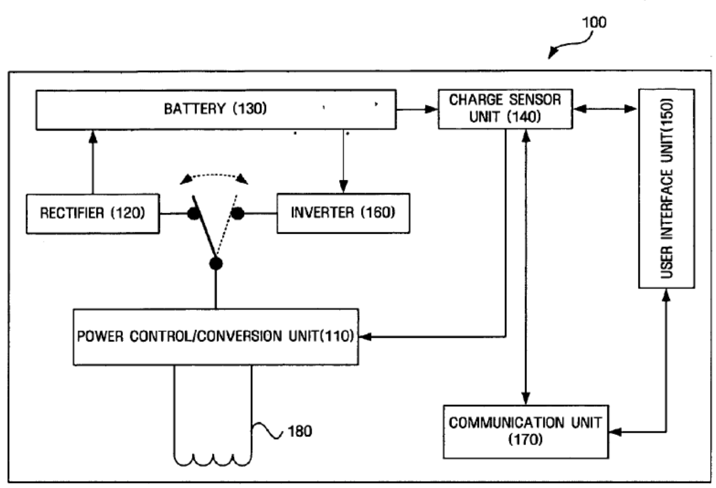
Finally, Requester reserves all rights and defenses available including, without limitation, defenses as to invalidity, unenforceability, and non-infringement regarding the '067 patent. Further, because the claim interpretation standard used by courts in patent litigation is different from the appropriate standard for this reexamination, any claim constructions submitted or implied herein for the purpose of this reexamination are not binding upon Requester in any litigation related to the ’067 patent. Specifically, any interpretation or construction of the claims presented herein or in Dr. Baker’s declaration submitted herewith, either implicitly or explicitly, should not be viewed as constituting, in whole or in part, the Requester’s own interpretation or construction of such claims.

VI. State of the Art

The references discussed herein generally reflect the state of the art by the ’067 patent’s June 30, 2015, filing date. In addition to the references discussed as part of the SNQ’s, however, Requester desires to bring the following additional references to the Examiner’s attention to provide background, context, and general information about the state of the art at the time of the alleged invention. Each of these references discloses the core concept of the ’067 patent—bi-directional wireless power transfer.

- ***Sagoo***. Samsung Electronics Co., Ltd., filed a patent application directed to an “apparatus and method of wirelessly sharing power by an inductive method” in 2006. (Ex. SA-1, Cover, Abstract.) The application generally describes wirelessly sharing power between two mobile devices, where either device can act as the transmitter or the receiver. As shown in Figure 3 below, the invention could switch between an inverter mode (for transmitting) and a rectifier mode (for receiving) wireless power.

FIG. 3



(*Id.*, FIG. 3.)

- ***Linder***. In 2013, Fulton Innovation demonstrated and offered for sale a bi-directional wireless charging system at CES 2013 using a modified Samsung Tab 2 7-inch tablet. (Ex. SA-2.) Brad Linder of Liliputing.com published an article including photographs and a video describing the Fulton Innovations system. (*Id.*) The tablet of the Fulton system is shown below wirelessly transmitting power to a Samsung mobile phone.

(*Id.*, 2.)

- ***Cook***. Qualcomm Incorporated filed a patent application directed to "bidirectional wireless power transmission" in 2009. (Ex. SA-3, Cover, Title.) The specification describes circuit diagrams for bi-directional wireless power transmission and illustrates "various operational contexts for an electronic device configured for bidirectional wireless power transmission" in accordance with the invention, such as the electronic device 300 shown below sharing power with devices 304A and 304B. (*Id.*, 1:66-2:17, 6:51-7:10.)

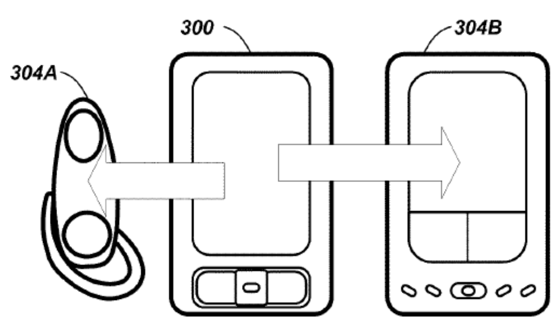


FIG. 6B

(*Id.*, FIG. 6B.)

- ***Kasar***. In June 2015, before the ’067 patent was filed, Apple Inc. filed a patent application directed to “[a]n electronic device and methods for inductively charging an electronic device using another external electronic device.” (Ex. SA 4, Cover, Abstract.) The system included an “inductive coil” with “two or more operational modes, including a power receiving operational mode for wirelessly receiving power and a power transmitting operational mode for wirelessly transmitting power.” (*Id.*, Abstract.) Although the PTAB considered Kasar and determined that it did not disclose the claimed magnetic core piecepart (*see supra* Section IV), Kasar reflects other aspects of the state of the art.

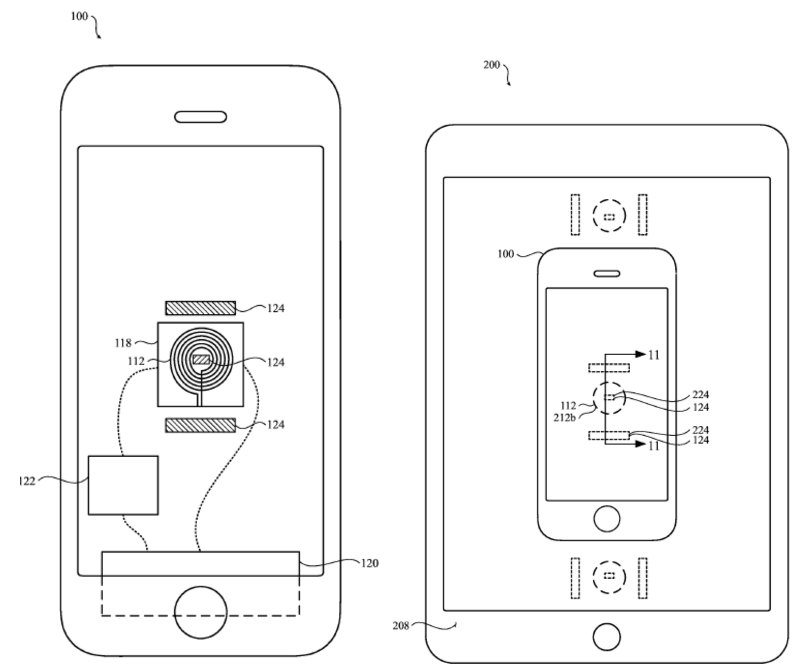


FIG. 2

FIG. 10

(*Id.*, FIGs. 2, 10.)

VII. Statement of Substantial New Questions of Patentability

As mentioned above, *Jang*, *Brockmann*, *Yang*, *Kardolus*, *Lee*, *Jeong*, *Madawala*, *Chao*, *Anguelov*, and *Soar* were never made of record or considered by the Office during original prosecution. But the references (as discussed below) disclose or suggest all of the features of claims.

<u>SNQ1</u>: *Jang* in view of *Brockmann* raises a substantial new question of patentability (SNQ1) with respect to claims 1, 7, 9, and 15-16 of the ’067 patent.

SNQ2: *Jang* in view of *Brockmann* and *Yang* raises a substantial new question of patentability (SNQ2) with respect to claim 8 of the ’067 patent.

SNQ3: *Jang* in view of *Brockmann* and *Kardolus* raises a substantial new question of patentability (SNQ3) with respect to claim 9 of the ’067 patent.

SNQ4: *Jang* in view of *Brockmann* and *Lee* raises a substantial new question of patentability (SNQ4) with respect to claims 10 and 11 of the ’067 patent.

SNQ5: *Jang* in view of *Brockmann* and *Madawala* raises a substantial new question of patentability (SNQ5) with respect to claims 12 and 17 of the ’067 patent.

SNQ6: *Jang* in view of *Soar* raises a substantial new question of patentability (SNQ6) with respect to claims 1, 7, 9, 15, and 16 of the ’067 patent.

SNQ7: *Jang* in view of *Soar* and *Yang* raises a substantial new question of patentability (SNQ7) with respect to claim 8 of the ’067 patent.

SNQ8: *Jang* in view of *Soar* and *Kardolus* raises a substantial new question of patentability (SNQ8) with respect to claim 9 of the ’067 patent.

SNQ9: *Jang* in view of *Soar* and *Lee* raises a substantial new question of patentability (SNQ9) with respect to claims 10 and 11 of the ’067 patent.

SNQ10: *Jang* in view of *Soar* and *Madawala* raises a substantial new question of patentability (SNQ10) with respect to claims 12 and 17 of the ’067 patent.

SNQ11: *Jeong* in view of *Chao* raises a substantial new question of patentability (SNQ11) with respect to claims 1, 7, 15, and 16 of the ’067 patent.

SNQ12: *Jeong* in view of *Chao* and *Yang* raises a substantial new question of patentability (SNQ12) with respect to claim 8 of the ’067 patent.

SNQ13: *Jeong* in view of *Chao* and *Kardolus* raises a substantial new question of patentability (SNQ13) with respect to claim 9 of the ’067 patent.

SNQ14: *Jeong* in view of *Chao* and *Lee* raises a substantial new question of patentability (SNQ14) with respect to claims 10 and 11 of the ’067 patent.

SNQ15: *Jeong* in view of *Chao* and *Madawala* raises a substantial new question of patentability (SNQ15) with respect to claims 12 and 17 of the ’067 patent.

SNQ16: *Jeong* in view of *Soar* raises a substantial new question of patentability (SNQ16) with respect to claims 1, 7, 15, and 16 of the ’067 patent.

SNQ17: *Jeong* in view of *Soar* and *Yang* raises a substantial new question of patentability (SNQ17) with respect to claim 8 of the ’067 patent.

SNQ18: *Jeong* in view of *Soar* and *Kardolus* raises a substantial new question of patentability (SNQ18) with respect to claim 9 of the ’067 patent.

SNQ19: *Jeong* in view of *Soar* and *Lee* raises a substantial new question of patentability (SNQ19) with respect to claims 10 and 11 of the ’067 patent.

SNQ20: *Jeong* in view of *Soar* and *Madawala* raises a substantial new question of patentability (SNQ20) with respect to claims 12 and 17 of the ’067 patent.

SNQ21: *Anguelov* in view of *Jang* raises a substantial new question of patentability (SNQ21) with respect to claims 1, 7, 10-12, and 15-17 of the ’067 patent.

Thus, for these reasons and the reasons discussed below and in the accompanying declaration of Dr. Jacob Baker (Ex. PA-DEC), the above grounds raise substantial new questions of patentability with respect to the ’067 patent.

- Proposed rejection 1, in Section VIII.B.1, discussed below in Section VII.A, corresponds to SNQ1;
- Proposed rejection 2, in Section VIII.B.2, discussed below in Section VII.B, corresponds to SNQ2;
- Proposed rejection 3, in Section VIII.B.3, discussed below in Section VII.C, corresponds to SNQ3;
- Proposed rejection 4, in Section VIII.B.4, discussed below in Section VII.D, corresponds to SNQ4;
- Proposed rejection 5, in Section VIII.B.5, discussed below in Section VII.E, corresponds to SNQ5;
- Proposed rejection 6, in Section VIII.B.6, discussed below in Section VII.F, corresponds to SNQ6;
- Proposed rejection 7, in Section VIII.B.7, discussed below in Section VII.G, corresponds to SNQ7;
- Proposed rejection 8, in Section VIII.B.8, discussed below in Section VII.H, corresponds to SNQ8;
- Proposed rejection 9, in Section VIII.B.9, discussed below in Section VII.I, corresponds to SNQ9;

- Proposed rejection 10, in Section VIII.B.10, discussed below in Section VII.J, corresponds to SNQ10;
- Proposed rejection 11, in Section VIII.B.11, discussed below in Section VII.K, corresponds to SNQ11;
- Proposed rejection 12, in Section VIII.B.12, discussed below in Section VII.L, corresponds to SNQ12;
- Proposed rejection 13, in Section VIII.B.13, discussed below in Section VII.M, corresponds to SNQ13;
- Proposed rejection 14, in Section VIII.B.14, discussed below in Section VII.N, corresponds to SNQ14;
- Proposed rejection 15, in Section VIII.B.15, discussed below in Section VII.O, corresponds to SNQ15;
- Proposed rejection 16, in Section VIII.B.16, discussed below in Section VII.P, corresponds to SNQ16;
- Proposed rejection 17, in Section VIII.B.17, discussed below in Section VII.Q, corresponds to SNQ17;
- Proposed rejection 18, in Section VIII.B.18, discussed below in Section VII.R, corresponds to SNQ18;
- Proposed rejection 19, in Section VIII.B.19, discussed below in Section VII.S, corresponds to SNQ19;
- Proposed rejection 20, in Section VIII.B.1, discussed below in Section VII.T, corresponds to SNQ20; and
- Proposed rejection 21, in Section VIII.B.21, discussed below in Section VII.U, corresponds to SNQ21.

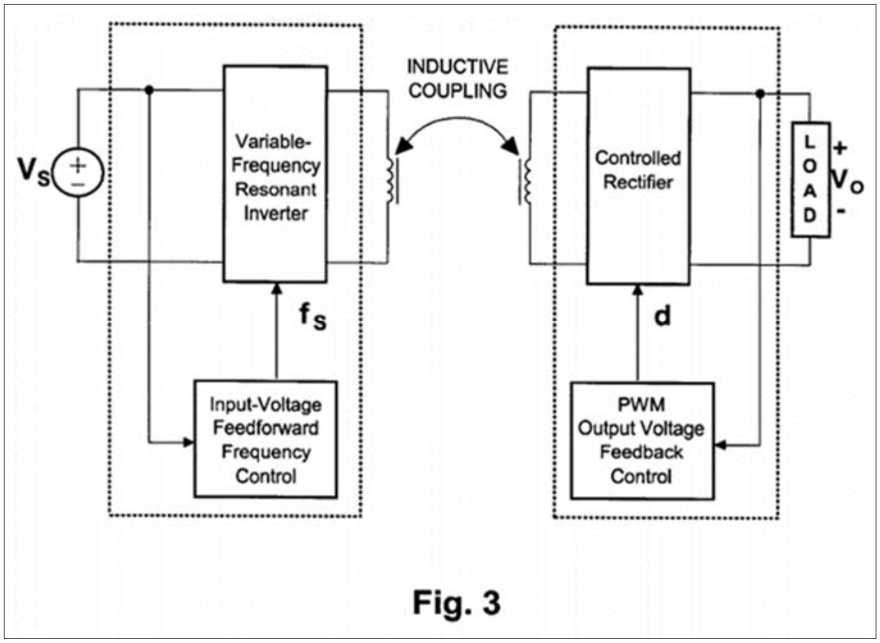
A. SNQ1: *Jang* in view of *Brockmann* Renders Obvious Claims 1, 7, 9, 15, and 16

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Brockmann* discloses or suggests the limitations of claims 1, 7, 9, and 15-16 of the ’067 patent. (Ex. PA-DEC, ¶48.)

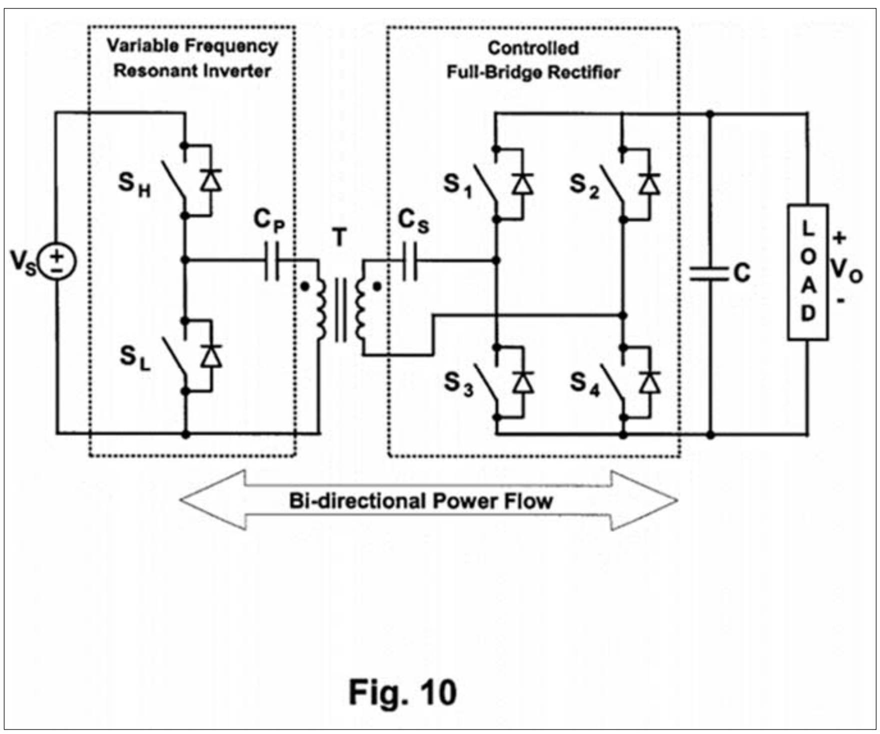
1. Overview of *Jang*

Jang relates to wireless power systems for portable devices. For instance, *Jang* discloses "a contactless electrical energy transmission [(CEET)] system in which a transformer provides the only coupling between the power transmitter and the power receiver." (Ex. PA-1, 1:5-8.) The converters disclosed by *Jang* deliver power wirelessly and maintain "distinct advantages over the conventional energy transmission system which uses wires and connectors." (*Id.*, 1:12-14.) More generally, the CEET technology adopted by *Jang* has allowed "portable telephones to increase their reliability by eliminating the contacts between their battery charger and the battery." (*Id.*, 1:26-28.)

Jang discloses various "bi-directional" power circuits that provided greater efficiency and precision than conventional CEET applications of the time. (*Id.*, 2:63-3:24 (emphasis added) ("A CEET approach which can simultaneously achieve high efficiency and precise voltage regulation must be implemented with a topology which allows a controlled bi-directional power flow through the transformer . . . . In this invention, a high-frequency, high-efficiency, fully regulated CEET system suitable for applications with a wide input range and wide load range is described. . . . The high efficiency of the system is achieved . . . by [] employing high-frequency-inverter and a controlled-rectifier topologies that allow for **bi-directional power flow** through the transformer. With the ability of the system to transfer power through the transformer in both directions, i.e., from the input to the output, and vice vers[a], the energy stored in the leakage inductances can be either transferred to the output, or the input, depending on the load requirement.") By describing "controlled bi-directional power flow through the transformer" with "local regulation in both the transmitter and receiver," Figure 3, for example, demonstrates how power can be transferred "from the input to the output, and vice versa," and how controls on each side of the system regulate power output. (*Id.*, 3:21, 3:26-31.) Figure 10 illustrates an embodiment of the bi-directional power system where switching circuits comprise the inverter and rectifier. (*Id.*, FIG. 10.)



(*Id.*, FIG. 3.)



(*Id.*, FIG. 10.)

Jang also discloses that the power circuits of the CEET systems "are inductively coupled trough [sic] a transformer." (*Id.*, 4:3-8.) Figure 10 provides a schematic diagram of a bi-directional rectifier, showing two windings configured to form a transformer that enables "bi-directional" wireless power transmission. (*Id.*, FIG. 10.) "[B]ecause both the inverter and the rectifier can conduct current in both directions," the system can provide wireless flow "from the source to the load, and vice vers[a]." (*Id.*, FIG. 10, 7:8-11.) Use of a "synchronous rectifier" or "full-wave bi-directional rectifier, as shown in FIG. 10" improves the conversion efficiency of the CEET system. (*Id.*, FIG. 10, 7:5-14.) *Jang* also discloses that the transformer may be "built using ferrite cores (2624Z) with the primary winding (210 turns of AWG#31 magnet wire) and the secondary winding (9 turns of AWG#26 magnet wire)." (*Id.*, 7:21-24.)

Successful wireless power transfer in the *Jang* CEET occurs over a switching cycle, with stages T_1-T_{10} corresponding to different topological stages of the circuit as illustrated in Figure 6. (*Id.*, FIG. 6, 4:56-57, 5:62.) Shown in Figure 6 are a first control circuit on the primary side of the transformer, which is used to vary the switching frequency of the inverter, and a second control circuit on the secondary side of the transformer, which is used to regulate voltage by controlling the transfer of energy to the rectifier. (*Id.*, FIG. 6, 8:14-27.) These switching circuits may also operate in a "burst" mode, in which "light load efficiency can be maximized" by turning off the inverter and restarting it after a pre-set period of time. (*Id.*, 7:1-4.)

More generally, *Jang* discloses wireless, or "contactless," bi-directional charging devices and is in the same or similar technical field as the '067 patent. (*Id.*, Abstract; Ex. PAT-A, 4:37-42 ("The power system as introduced herein…preserv[es] the efficiency and bidirectional power flow obtained by the metallic contact battery power systems…[and] eliminates the metallic contacts."); Ex. PA-DEC, ¶53.) To the extent *Jang* is not in the field of endeavor of the '067 patent (it is), *Jang* is reasonably pertinent to problems associated with charging contacts, power efficiency, power control, and power safety, problems with which the inventor was involved. (Ex. PA-1, FIGs. 3, 10; *id.*, 1:5-10 ("[A]n energy efficient system . . . tightly regulates the output against the input voltage and output current changes."); *id.*, 1:19-21 ("CEET systems have been developed . . . because of their potential enhanced safety, reliability, and convenience."); Ex. PAT-A, 3:33-4:39 (describing problems associated with conventional, non-wireless power contacts)*; id.*, 4:20-40 (describing power efficiency, voltage scaling, and safety aspects of disclosed power systems); Ex. PA-DEC, ¶53.) It is also pertinent to problems associated with mechanical structure and controllable switching circuits of contactless power systems. (Ex. PA-1, 2:12-21, 2:35-62; Ex. PAT-A, 1:44-56; Ex. PA-DEC, ¶53.)

2. Overview of *Brockmann*

Brockmann relates to a charging device for charging batteries in a mobile electrical device, for example a radiotelephone, a cordless telephone, or the like, in which the energy is inductively transmitted from a charging device to the mobile device coupled by an alternating magnetic field. (Ex. PA-2, 1:5-10.; *id.*, 4:55-57 ("FIG. 1 shows a charging unit CU for charging an accumulator battery B in a mobile electrical device MD, which in the current example is a mobile telephone.").) Figure 1 of *Brockmann* details a first ferrite core piece F1 and a second ferrite core piece F2. (Ex. PA-2, FIG. 1; EX. PA-DEC, ¶54.)

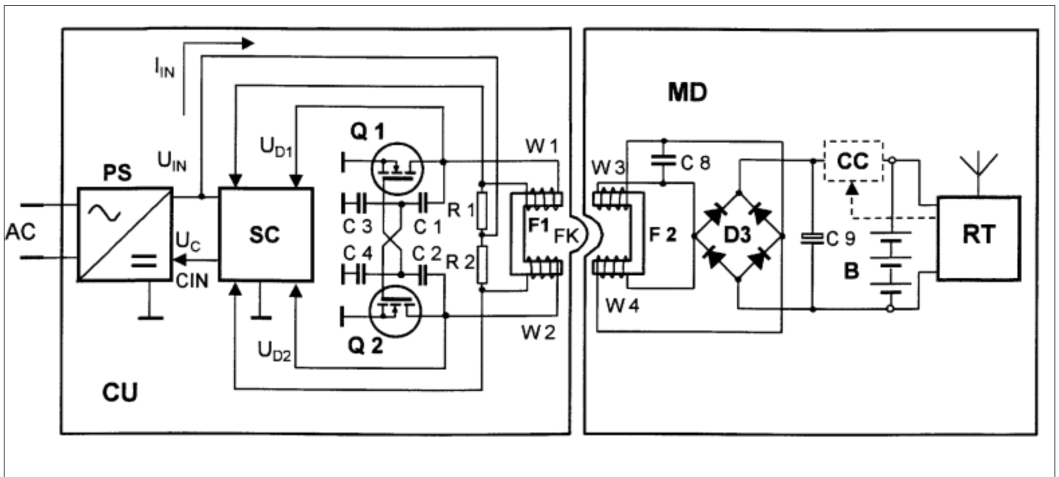


FIG. 1

(*Id.*, FIG. 1.)

Brockmann discloses first and second coils wound around the ferrite cores. (Ex. PA-DEC, ¶55.) For instance, *Brockmann* discloses "[t]he primary windings W1, W2 generate the alternating magnetic field required for the energy transmission and are advantageously connected to the arm ends of a U-shaped ferrite core F1, which is disposed close beneath the surface of the housing of the charging unit CU." (Ex. PA-2, 5:15-20.) *Brockmann* further discloses "[t]he secondary windings W3, W4, analogous to the primary windings W1, W2, are advantageously disposed on the arm ends of a second U-shaped ferrite core F2, which is disposed close beneath the surface of the housing of the mobile device MD." (*Id.*, 5:46-50.)

Brockmann also teaches the manner of alignment between the mobile device and charging unit. *Brockmann* discloses the first core/coil arrangement is configured to be coupled to, aligned with and removable from the second core/coil arrangement. (*Id.*, FIG. 1; *id.*, 5:57-61 ("In order to enable a correct approach of the mobile device MD toward the charging unit CU and thus an optimal magnetic coupling, the housing of the charging unit CU has a mechanical guide FK and/or mount, which is adapted to the shape of the mobile device MD.").) *Brockmann* discloses that the arrangement of the charging unit CU and the mobile device MD form a transformer. (Ex. PA-DEC, ¶56.)

Brockmann, for instance, discloses that a battery is connected to coils in order to be charged. (*Id.*, 6:11-19 ("The coupling of the load to the secondary-side resonance circuit C8, W3, W4 is carried out by way of a charging rectifier D3, in this case a bridge rectifier. By way of a charging capacitor C9, this charging rectifier D3 supplies the charging output voltage U for the accumulator battery B. A charging control circuit CC can be connected between the charging rectifier D3 and the accumulator battery B, and this control circuit CC interrupts the power supply to the accumulator battery B when it is fully charged.").)

3. Claim 1

a. [1.a] An apparatus, comprising:

To the extent the preamble is limiting, *Jang* discloses this limitation. (Ex. PA-DEC, ¶¶58-59.) For example, Figure 3 illustrates a contactless electrical energy transmission ("CEET") system, including an "output side" ("apparatus"), having "a controlled bi-directional rectifier." (Ex. PA-1, 3:43-56, 4:3-8, FIGs. 3, 10; Ex. PA-DEC, ¶58.)

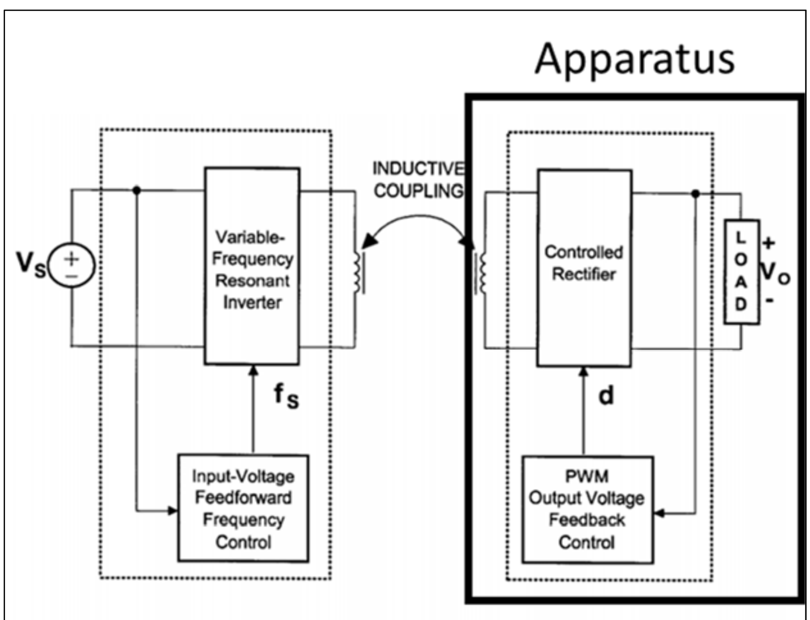


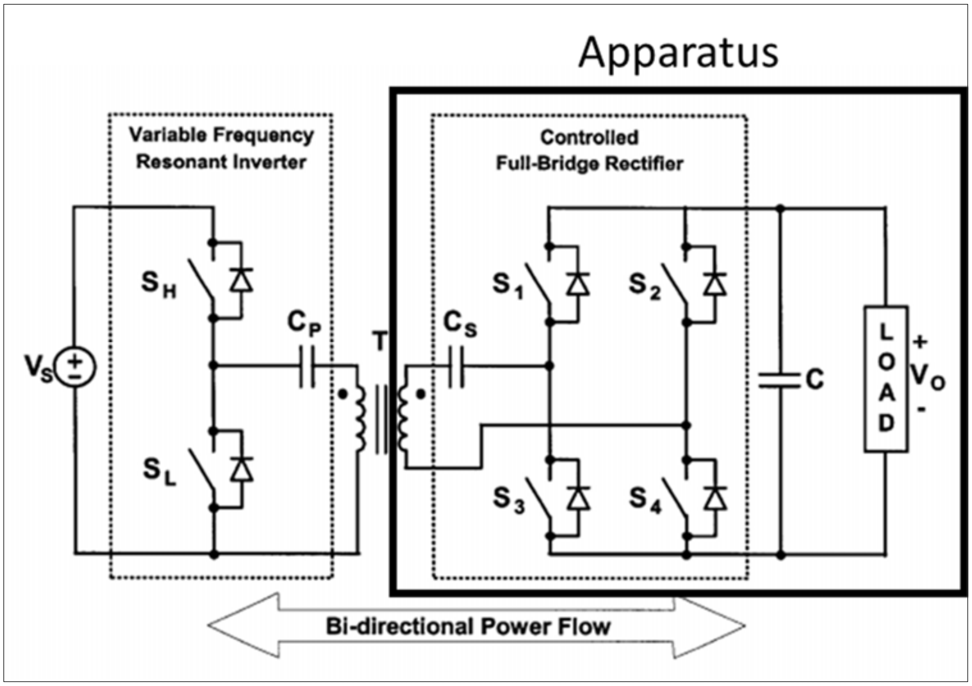
Fig. 3

(Ex. PA-1, FIG. 3 (annotated); Ex. PA-DEC, ¶58.)

Jang's CEET system transfers power wirelessly to and from a load through a transformer connected to a switching circuit. (Ex. PA-1, Abstract, 4:4-5, FIGs. 3, 9, 10.) In the system, "a transformer provides the only coupling between the power transmitter and the power receiver." (*Id.*, 1:5-8.)

Jang describes multiple variations of the Figure 3 CEET system, where Figure 4 shows an implementation of the CEET system with a series resonant inverter (*id.*, 3:46-49, 4:34-36 (Figure 5 shows the same circuit as Figure 4 but where the circuit diagram includes leakage and magnetizing inductances of the transformer), 3:50-53, 4:41-43), and Figures 9 and 10 show implementations of the same Figure 4/5 CEET system where the apparatus has a synchronous rectifier (a half-bridge rectifier) or a full-wave bi-directional rectifier (full-bridge rectifier), respectively (*id.*, 3:59-63, 7:5-14). (Ex. PA-DEC, ¶60.) The rectifiers in the apparatus of Figures 9 and 10 "allow[] bi-directional flow from the source to the load and vice-vers[a]." (Ex. PA-1, 7:8-14 ("[T]he implementation in FIG. 9 allows bi-directional flow from the source to the load, and vice-vers[a], because both the inverter and the rectifier can conduct current in both directions. The CEET system with bi-directional power flow can be also implemented with full-wave bi-directional rectifier, as shown in FIG. 10.").)

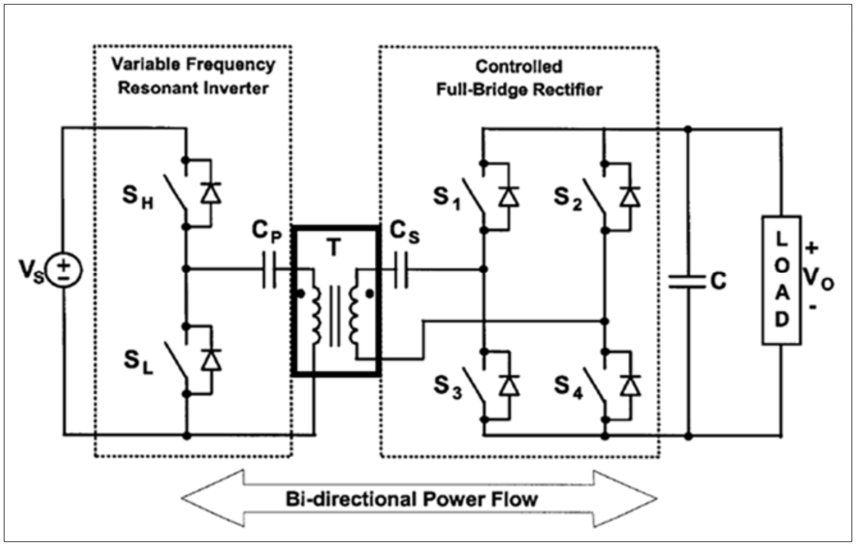
The apparatus of Figure 10 is referred to herein, but generally the apparatus of Figure 9 can be considered interchangeably, because the only difference is the number of switches in the rectifier. (*Id.*, FIGs. 9-10, 7:5-13; Ex. PA-DEC, ¶61.)



(Ex. PA-1, FIG. 10 (annotated) (illustrating that the bidirectional power system may include a "full-bridge rectifier"); Ex. PA-DEC, ¶61.).)

b. [1.b] a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer; and

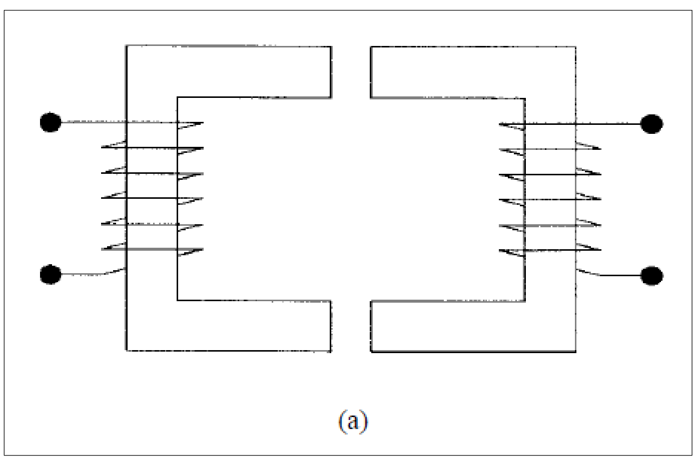
Jang in view of *Brockmann* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶62-75.) For example, *Jang* discloses or suggests "a first magnetic core piecepart having a first metallic coil encircling at least a portion . . . [and] a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer." The *Jang* inductive power system is implemented with a wireless "transformer." (Ex. PA-1, 4:3-7.) Indeed, the Figure 10 embodiment illustrates a transformer circuit diagram for the inductive power system. (*Id.*, FIG. 10; Ex. PA-DEC, ¶¶63.)



(Ex. PA-1, FIG. 10 (transformer annotated in black box); Ex. PA-DEC, ¶63.)

With respect to the Figure 10 embodiment, however, *Jang* does not explicitly disclose the components of the transformer circuit. But *Jang* describes these details in another embodiment. (Ex. PA-DEC, ¶63.) Specifically, *Jang* discloses that a transformer for a wireless inductive power system can be "built using ferrite cores (2624Z)" with a "secondary winding (9 turns of AWG#26 magnet wire)" ("a first metallic coil") and a "primary winding (210 turns of AWG#31 magnet wire)" ("a second magnetic coil"). (Ex. PA-1, 7:14-24.) *Jang* discloses or suggests that the ferrite cores (first and second "magnetic core pieceparts") are encircled by the transformer coils because the coils are windings and transformer windings were well-known to wrap around cores. (*Id.*; Ex. PA-DEC, ¶63; Ex. PAT-A, 5:25-29 (disclosing that a magnetic core piecepart is "typically composed of . . . a soft ferrite, powered iron, or some other ferromagnetic substance with high magnetic permeability"); Ex. PA-7, 2, FIG. 1 (illustrating an example of primary and secondary "winding[s]" of a wireless transformer, wherein the windings wrap around magnetic structures of the transformer); Ex. PA-13, 12:31-59, FIGs. 1A-C (same); Ex. PA-14, 1:22-32 ("Inductive chargers have . . . been proposed in a number of documents such as U.S. Pat. No. 6,356,049, U.S. Pat. No. 6,301,128, U.S. Pat. No. 6,118,249. These inductive chargers . . . use traditional transformer designs with windings wound around ferrite magnetic cores.").) Thus, it would have been obvious to form the Figure 10 transformer with "a first magnetic core piecepart having a first metallic coil encircling at least a portion . . . [and] a second magnetic core piecepart having a second metallic coil encircling at least a portion." The motivation would have been to implement the transformer with the benefits understood by *Jang* or for the added efficiency associated with transformer circuits that include cores. (Ex. PA-DEC, ¶¶63; *see, e.g.*, Ex. PA-13, 7:67-8:3 ("The substantially closed magnetic path formed between the primary and secondary coil and core assemblies provides for the efficient transmission of power."); *id.*, 17:37-42 ("Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core.").) A POSITA would have had a reasonable expectation of success in such an implementation, as *Jang* suggests this implementation and the claimed feature would have involved no more than the use of known technique to improve a known device in a similar way (e.g., wireless transformer circuits with coils that encircle magnetic core pieceparts). *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Indeed, a POSITA would have understood that the coils suggested by *Jang* would encircle the cores as such "mechanical structures for CEET systems" were well-known and discussed in other references. (Ex. PA-1, 2:12-20; Ex. PA-DEC, ¶64.) One such reference *Jang* cites is D. A. G. Pedder *et al.*, "A Contactless Electrical Energy Transmission System," 46 IEEE Trans. Industrial Electronics 1, 23-30 (Feb. 1999) ("*Peddler*"). (Ex. PA-1, 2:13-16, 7:46-49.) *Pedder* discloses a "contactless electrical energy transmission system," like *Jang*, where "[a] transformer may be used to supply electrical energy a load and, at the same time provide galvanic isolation. If the primary and secondary windings of the transformer are wound on separate magnetic structures," that is separate magnetic core pieceparts "as shown in Fig. 1(a), then energy coupling is possible without physical connection between the source and load units." (Ex. PA-7, 23.)



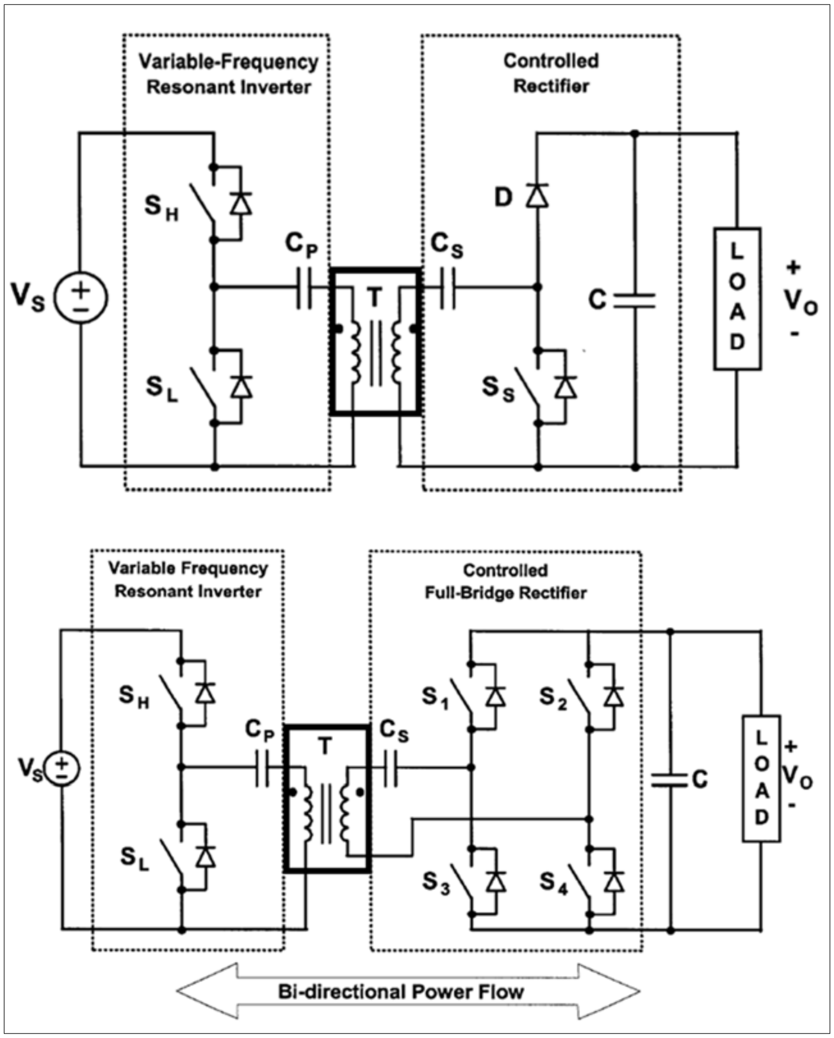
(*Id.*, FIG. 1(a) (illustrating "primary and secondary windings of the transformer . . . wound on separate magnetic structures").) Thus, to the extent *Jang* does not explicitly illustrate coils encircling magnetic core pieceparts, *Pedder* demonstrates that *Jang* considered such a configuration to be applicable to its CEET systems and well-known in the art. (Ex. PA-DEC, ¶64; *see also* Ex. PA-13, 12:31-59, FIGs. 1A-C (illustrating an example of primary and secondary "winding[s]" of a wireless transformer, wherein the windings wrap around magnetic structures of the transformer); Ex. PA-14, 1:22-32 ("Inductive chargers have . . . been proposed in a number of documents such as U.S. Pat. No. 6,356,049, U.S. Pat. No. 6,301,128, U.S. Pat. No. 6,118,249. These inductive chargers . . . use traditional transformer designs with windings wound around ferrite magnetic cores.").)

Similarly, *Jang* discloses or suggests the "magnetic core piecepart" under the District Court's construction, *see supra* Section V, where the "magnetic core piecepart" is a "core piece that is made of magnetic material," because as described above, a POSITA would have understood that the coupled inductors that form transformers are comprised of magnetic cores. (Ex. PA-DEC, ¶65.) Likewise, *Jang* discloses or suggests the "magnetic core piecepart" under the Board's construction, *see supra* Section V, where the "magnetic core piecepart" is "a magnetic part that cooperates with at least one other magnetic part to create a flux path that passes through the first and second metallic coils." As described above, a POSITA would have understood that the coupled inductors that form transformers are comprised of magnetic cores and have metallic coils wound around them, and are configured to cooperate with one another to create a flux path that passes through the two metallic coils. (Ex. PA-DEC, ¶65; *see, e.g.*, PA-13, 17:33-42 ("When the primary coil is energized with an alternating current, a magnetic field is produced such that magnetic flux is emitted from the ferrite core pole faces 6 allowing magnetic or inductive coupling to a secondary ferrite core and winding. Two coil windings could also be placed adjacent to or within each other without utilising ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core and would be omni-directional.").)

A POSITA would have understood that *Jang*'s two magnetic core pieceparts separated by an "air gap," Ex. PA-1, 7:21-37, are configured to be coupled to, aligned with, and removable from one another to form the transformer. (Ex. PA-DEC, ¶66.)

"coupled to"

Jang discloses, for example, that "[t]he system consists of a variable-frequency (VF) resonant inverter at the input side and a controlled bi-directional rectifier at the output side that are inductively **coupled** through a transformer." (*Id.*, 4:5-8 (emphasis added).) Further, several of *Jang*'s figures show coupled inductors forming a transformer. (*Id.*, FIGs. 3-6, 8-10; *see also id.*, 3:47-49 ("FIG. 4 Schematic diagram of inductive-coupled power stage with a series-resonant inverter and controlled rectifier as example of an embodiment of the present invention").)



(*Id.*, FIG. 4 (top), FIG. 10 (bottom) (coupled transformer annotated in black box).) A POSITA would have understood that the magnetic core pieceparts are configured to be coupled, because without corresponding magnetic (or flux) coupling, there would be no wireless transfer of power through the transformer. (Ex. PA-DEC, ¶67.)

"aligned with"

Jang's figures illustrate that the two magnetic core pieceparts are aligned with each other. (*Id.*, FIGs. 3-6, 8-10; *see also id.*, 3:47-49 ("FIG. 4 Schematic diagram of inductive-coupled power stage with a series-resonant inverter and controlled rectifier as example of an embodiment of the present invention").) For instance, Figures 4 and 10 (annotated above) show the components that form the transformer T are aligned and, as discussed above, the transformer comprises the magnetic core pieceparts. (*Id.*, FIGs. 4, 10.) Further, *Jang* does not state that there is anything which would or could prevent the inductors from being aligned in the wireless inductive power system. Thus, they are "configured to be . . . aligned." Because the windings are around the cores (as explained above), the aligned inductors represent aligned cores. (Ex. PA-DEC, ¶68.)

"removable from"

Jang discloses that CEET systems have been developed for "electric vehicle battery-recharging applications," in "medical applications since it makes possible to transfer electric energy, which is required for running implanted electrical circulatory assist devices, through the intact skin of a patient," and "used in cordless electric tooth brushes and portable telephones to increase their reliability by eliminating the contacts between their battery charger and the battery." (*Id.*, 1:17-28.) A POSITA would have understood that these common wireless charging applications, like the *Jang* CEET systems, disclose cores that are removable from one another, otherwise the transmitter and receiver would be permanently fixed to one another. (Ex. PA-DEC, ¶69; Ex. PA-1, 1:17-28 (explaining various wireless, contactless CEET charging systems); *id.*, Abstract, FIGs. 3, 9-12 (disclosing various wireless, contactless CEET charging systems).)

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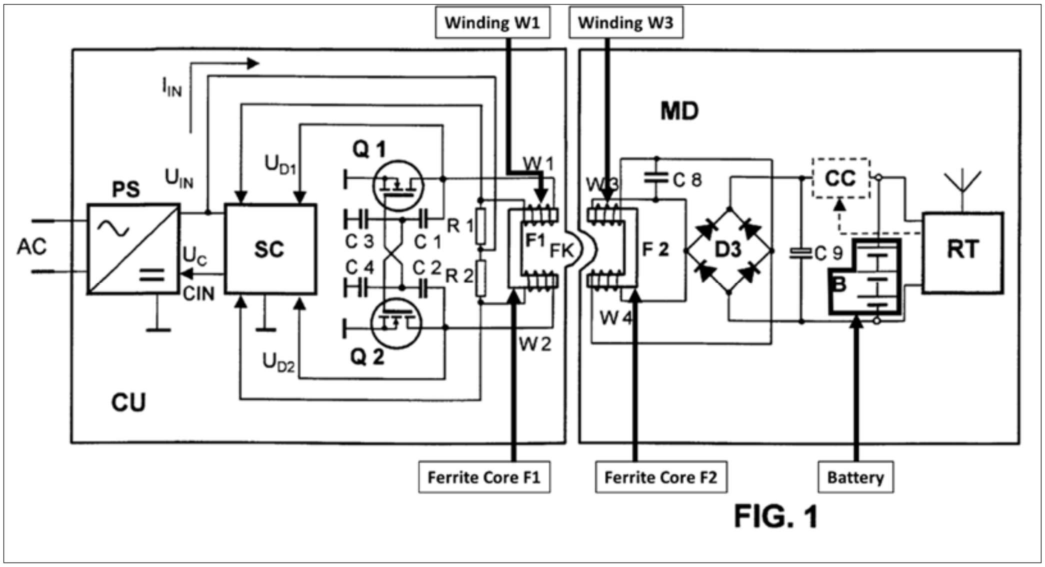
To the extent *Jang* does not suggest that the coils encircle the magnetic core pieceparts or that the magnetic core pieceparts are "configured to be coupled to, aligned with and removable from" each other to form the transformer, *Brockmann* discloses these features and it would have been obvious to implement *Jang*'s transformer using *Brockmann*'s transformer structure. (Ex. PA-DEC, ¶70.) *Brockmann*, similar to *Jang*, generally relates to "a charging device for charging batteries in a mobile electrical device, for example a radiotelephone, a cordless telephone, or the like, in which the energy is inductively transmitted from a charging device to the mobile device coupled by a[n] alternating magnetic field." (Ex. PA-2, 1:5-9; *see also id.*, Abstract.)

With reference to Figure 1, annotated below, *Brockmann* discloses a charging unit (CU) for charging a battery (B) in a mobile device (MD) such as a mobile telephone. (*Id.*, 4:55-57, FIG. 1; Ex. PA-DEC, ¶71.) The mobile device includes "U-shaped ferrite core F2" ("first magnetic core piecepart"), with winding W3 "advantageously disposed on the arm" of F2 ("having a first metallic coil encircling at least a portion thereof"). (*Id.*, 5:46-50.) The charging unit includes "U-shaped ferrite core F1" ("second magnetic core piecepart") with winding W1 "advantageously connected to the arm" of F1 ("a second metallic coil encircling at least a portion thereof"). (*Id.*, 5:15-20.)



(*Id.*, FIG. 1 (annotated) (illustrating metallic windings that encircle magnetic core pieceparts F1, F2); Ex. PA-DEC, ¶71.)

Brockmann further discloses that "[i]n order to enable a correct approach of the mobile device MD toward the charging unit CU and thus an optimal magnetic coupling, the housing of the charging unit CU has a mechanical guide FK and/or mount, which is adapted to the shape of the mobile device MD" ("configured to be coupled to, aligned with and removable from"). (*Id.*, 5:57-61). As shown in Figure 1, the mechanical guide FK is positioned between the cores F1 and F2, and therefore aligns the cores to create the "optimal magnetic coupling." (*Id.*, FIG. 1.) As *Brockmann* discloses that the cores can be aligned and coupled, and discloses no connection between them, it also discloses removable cores. (Ex. PA-DEC, ¶72.)

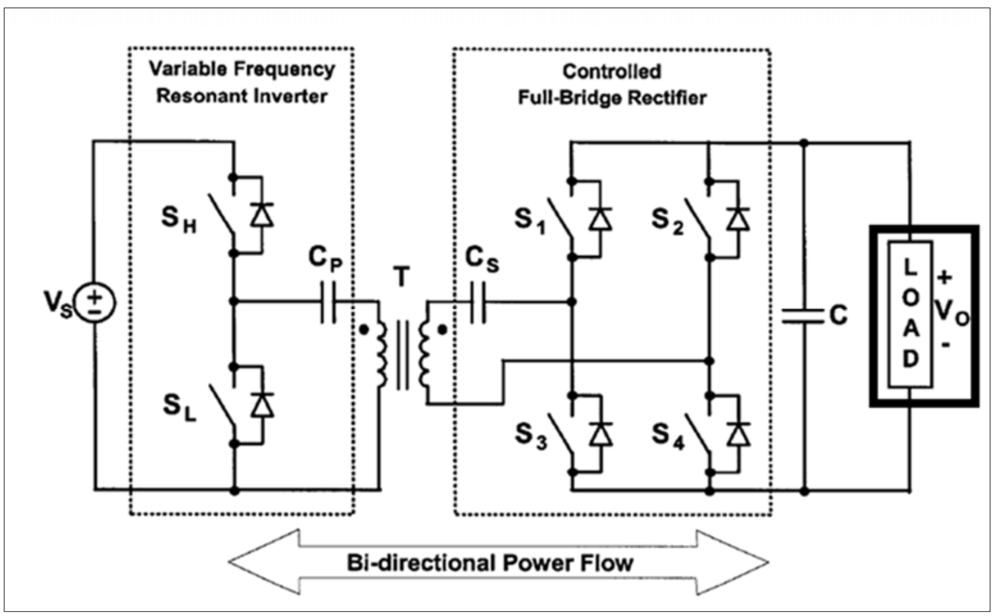
A POSITA would have been motivated to modify the bidirectional contactless electrical energy transmission system of *Jang* to include the magnetic transformer components of *Brockmann* and would have found it obvious to do so. (Ex. PA-DEC, ¶73.) Such a person would have looked to *Brockmann* at least because *Brockmann* is in a similar field to *Jang*. (*Id.*) For example, *Jang* concerns a contactless electrical energy transmission system that can be used in a portable telephone using magnetic induction, employing "specially constructed transformers" to transfer energy "inductively through air," (Ex. PA-1, 1:25-33), and *Brockmann* relates to "a charging device for charging batteries in a mobile electrical device, for example a radiotelephone, a cordless telephone, or the like, in which the energy is inductively transmitted from a charging device to the mobile device coupled by a[n] alternating magnetic field," and discloses structures for such specifically constructed transformers, (Ex. PA-2, 1:5-9). (Ex. PA-DEC, ¶73.)

A POSITA implementing *Jang*'s apparatus would have thus looked *Brockmann*, and would have been motivated to implement a ferrite core, partially encircled by a metallic coil and configured to be coupled to, aligned with, and removable from another ferrite core partially encircled with a metallic coil, as disclosed by *Brockmann* at least because *Brockmann* discloses various advantages of its core-coil arrangement. For instance, *Brockmann*'s coil-core arrangement "has the advantage that for the effective power transmission, the rear magnetic fluxes of the [windings] are closed." (Ex. PA-2, 5:62-66; Ex. PA-DEC, ¶74.) Indeed, a POSITA would have appreciated that ferrite cores with corresponding windings as claimed and disclosed by *Brockmann* increase the efficiency of wireless power transfers. (*See, e.g.*, Ex. PA-13, 17:33-42, FIG. 1 ("When the primary coil is energized with an alternating current, a magnetic field is produced such that magnetic flux is emitted from the ferrite core pole faces 6 allowing magnetic or inductive coupling to a secondary ferrite core and winding. Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core."); Ex. PA-DEC, ¶74.) Further, *Brockmann*'s cores "make an extremely flat design of a mobile telephone possible." (Ex. PA-2, 5:66-6:1.) A POSITA would have understood that such benefits are equally applicable to *Jang*'s transformer, which can be implemented in a mobile telephone. (Ex. PA-1, 1:25-33.) A POSITA would have had a reasonable expectation of success in such an implementation, as this claimed feature would have involved no more than the use of known technique to improve a known device in a similar way (e.g., using a coil-core configuration with known advantageous in a known CEET apparatus). (Ex. PA-DEC, ¶74.) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Jang in view of *Brockmann* also discloses or suggests the "magnetic core piecepart" under the District Court's construction, *see supra* Section V, where the "magnetic core piecepart" is a "core piece that is made of magnetic material," because as described above, a POSITA implementing *Jang*'s apparatus would have been motivated in view of *Brockmann* to implement a ferrite (magnetic) core. (Ex. PA-DEC, ¶75.) Likewise, *Jang* in view of *Brockmann* discloses or suggests the "magnetic core piecepart" under the Board's construction, *see supra* Section V, where the "magnetic core piecepart" is "a magnetic part that cooperates with at least one other magnetic part to create a flux path that passes through the first and second metallic coils." (Ex. PA-DEC, ¶75.) As described above, a POSITA would have been motivated to implement the *Jang* apparatus in view of *Brockmann* so that a ferrite core (magnetic part) partially encircled with a metallic coil is coupled to, aligned with, and removable from another ferrite core (i.e., cooperates with at least one other magnetic part), also encircled with a metallic coil, where the arrangement creates a flux path that passes through the two metallic coils. (Ex. PA-DEC, ¶75.)

c. [1.c] a battery metallically coupled to said first metallic coil and configured to be charged and discharged through an electrically isolating path of said transformer.

To start, *Jang* in view of *Brockmann* discloses or suggests "a battery metallically coupled to said first metallic coil." (Ex. PA-DEC, ¶76-82.) For example, *Jang* discloses a load that is metallically coupled to the first metallic coil. (*See* Ex. PA-1, FIG. 10.)



(Ex. PA-1, FIG. 10 (load in black box); Ex. PA-DEC, ¶76.)

The first metallic coil of the transformer is coupled to the load because the coil receives and transmits wireless power to charge or discharge the load, respectively. (*Id.*, 7:8-37, FIG. 10.) Although Figure 10 shows a controlled rectifier between the load and coil, the '067 patent defines "metallic" to refer to "without limitation, an electrical connection between two separate parts that is a wired or a contact that may include electrically conductive components such as semiconductor devices as well as current-conducting components such as resistors and inductors." (Ex. PAT-A, 3:48-53; *see also id.*, 5:17-19 ("It should be understood that the connection between the metallic coil 160 and battery will include components therebetween.") Thus, circuit diagram in *Jang*'s Figure 10 shows the claimed "metallic" coupling, as that term is defined in the '067 patent, and, accordingly, that the load is "metallically coupled to said first metallic coil." (Ex. PA-DEC, ¶76.)

Jang discloses or suggests that the "load" would have included a battery (which, as above, would have been "metallically coupled to said first metallic coil"). A "load" is a well-understood term for components of a circuit that consume power or energy, such as a battery being recharged. (Ex. PA-DEC, ¶¶77.) *Jang* describes CEET systems that "have been developed for electric vehicle **battery**-recharging," and for "cordless electric toothbrushes and portable telephones to increase their reliability by eliminating the contacts between their battery charger and the **battery**." (Ex. PA-1, 1:17-29 (emphasis added).) *Jang* even explains that a load is charged and discharged because the wireless power circuit is a "charger" and the circuit enables bidirectional power flow. (*Id.*, Abstract, FIG. 10, 7:14-15, 7:30-32.) Although *Jang* only uses the term "load" when describing its circuits, *Jang* plainly contemplates, and a POSITA would have understood, that the load in applications where a battery can be charged, such as those *Jang* discloses, is a battery. (Ex. PA-DEC, ¶77.) *Jang* also describes power flowing through the transformer from the load to the source, which means the "load" must be capable of providing power to the circuit. (Ex. PA-1, 7:5-13 ("[T]he implementation in FIG. 9 allows bi-directional flow from the source to the load, and vice-vers[a], because both the inverter and the rectifier can conduct current in both directions. The CEET system with bi-directional power flow can be also implemented with full-wave bi-directional rectifier, as shown in FIG 10.").) A battery is a load that is also capable of acting as a source. (Ex. PA-DEC, ¶77.)

Moreover, *Jang* explicitly illustrates an embodiment wherein the load of a transformer is a 5 V battery. (Ex. PA-1, Fig. 12, 7:38-41.)

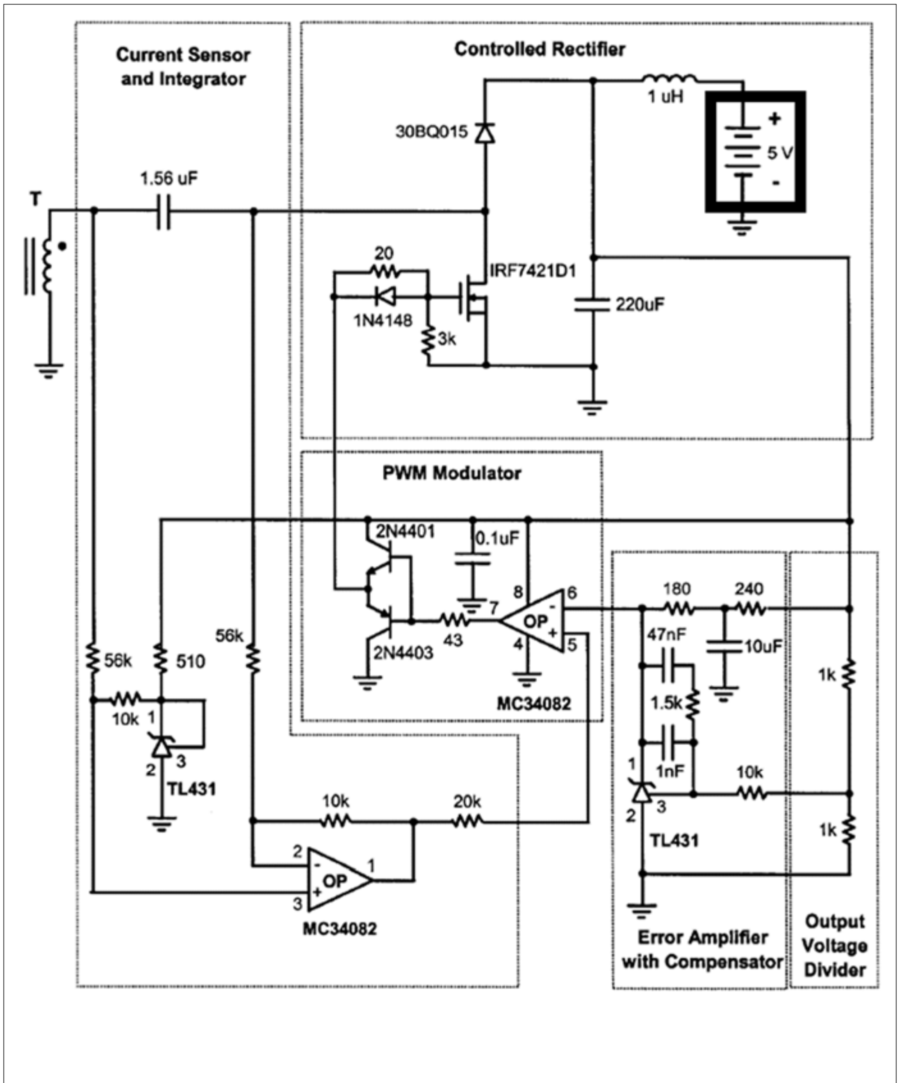


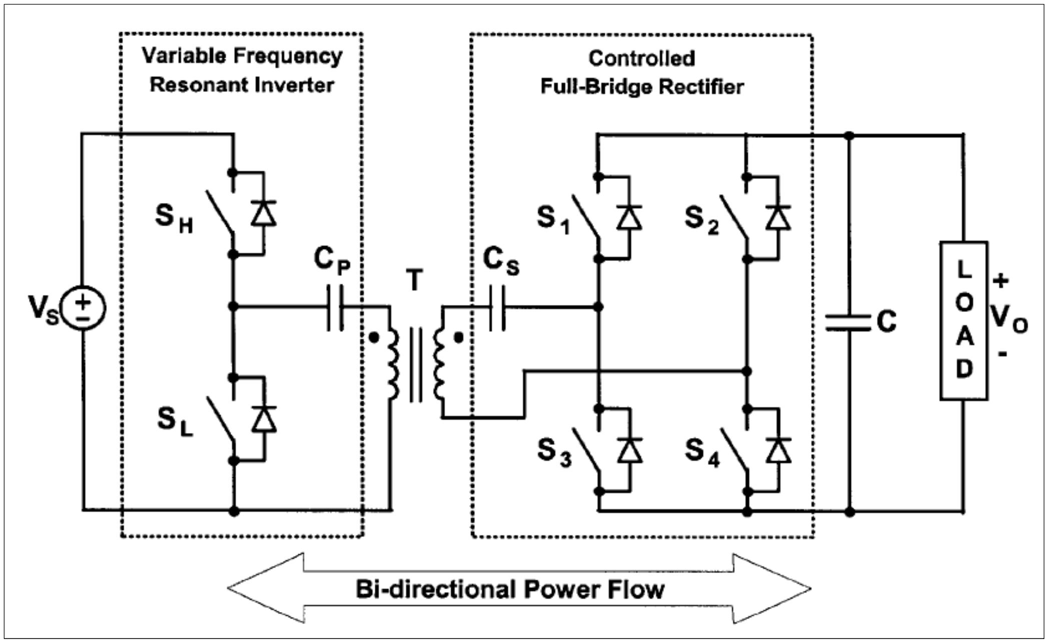
Fig. 12

(Ex. PA-1, FIG. 12 (battery in black box at top right); Ex. PA-DEC, ¶78.)

Given that the load is charged and discharged and even explicitly described as a battery in one embodiment, it would have been obvious for the load to be a battery as claimed. (Ex. PA-DEC, ¶79.) Using a battery for a load that could have been charged and discharged would have been nothing more than a simple substitution of a load element for a battery load to obtain a predictable wireless battery system. (Ex. PA-DEC, ¶79.) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007) ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."). Moreover, a POSITA would have been motivated to use a battery load as consumers desired a variety of wireless battery applications before the time of invention. (Ex. PA-1, 1:11-29 (describing various applications for wireless battery loads); Ex. PA-DEC, ¶79.) A POSITA would have had a reasonable expectation of success in such an implementation, as the proposed battery load was suggested by *Jang* and would have combined known technologies (e.g., battery loads and wireless power systems) according to known methods (e.g., charging and discharging a battery with a wireless power system) to yield the predictable result of a bidirectional wireless power system wherein the system contains a battery capable of being charged and discharged. (Ex. PA-DEC, ¶79.) *See KSR Intern. Co.*, 550 at 416.

Jang in view of *Brockmann* also discloses or suggests that the battery is "configured to be charged and discharged through an electrically isolating path of said transformer." (Ex. PA-DEC, ¶80.) For example, *Jang* describes "topologies that allow for bi-directional power flow through the transformer. With the ability of the system to transfer power through the transformer in both directions, i.e., from the input to the output, and vice vers[a], the energy . . . can either be transferred to the output, or the input." (Ex. PA-1, 3:14-25; *see also id.*, Abstract (emphasis added) ("**bi-directional power flow through the transformer**"), 2:65-66 (emphasis added) ("a topology which allows a controlled **bi-directional power flow through the transformer**"), 4:3-8 ("The system consists of a variable-frequency (VF) resonant inverter at the input side and a controlled bi-directional rectifier at the output side that are inductively coupled trough a transformer.").)

Specifically, *Jang* discloses a circuit topology in Figure 10 for bi-directional power flow between the source (on the left side of the figures) and the load (on the right side of the figures). (Ex. PA-1, 7:5-13 ("[T]he implementation in FIG. 9 allows bi-directional flow from the source to the load, and vice-vers[a], because both the inverter and the rectifier can conduct current in both directions. The CEET system with bi-directional power flow can also be implemented with full-wave bi-directional rectifier, as shown in FIG. 10.")



(Ex. PA-1, Fig. 10.)

And as described above, *Jang*'s load includes a battery. (Ex. PA-DEC, ¶81.) Therefore, because *Jang*'s apparatus is configured such that power can flow to and from the load through the transformer, (Ex. PA-1, FIG. 10), and that power would charge and discharge the battery (as explained above), *Jang* discloses or suggests an apparatus that configured to charge and discharge the battery through a transformer. (Ex. PA-DEC, ¶81.) Moreover, the *Jang* coils, as modified in view of *Brockmann* discloses coils encircling at least a portion of the magnetic core pieceparts and that the magnetic core piecepearts would be configured to be coupled to, aligned with and removable from each other to form the transformer. (*Supra* Section VII.A.3.b; Ex. PA-DEC, ¶81.) Thus, *Brockmann*'s coil and core structure and magnetic core piecepart configurations do not change how the battery would have been metallically coupled to said first metallic coil and configured to be charged and discharged through the transformer. (Ex. PA-DEC, ¶81.)

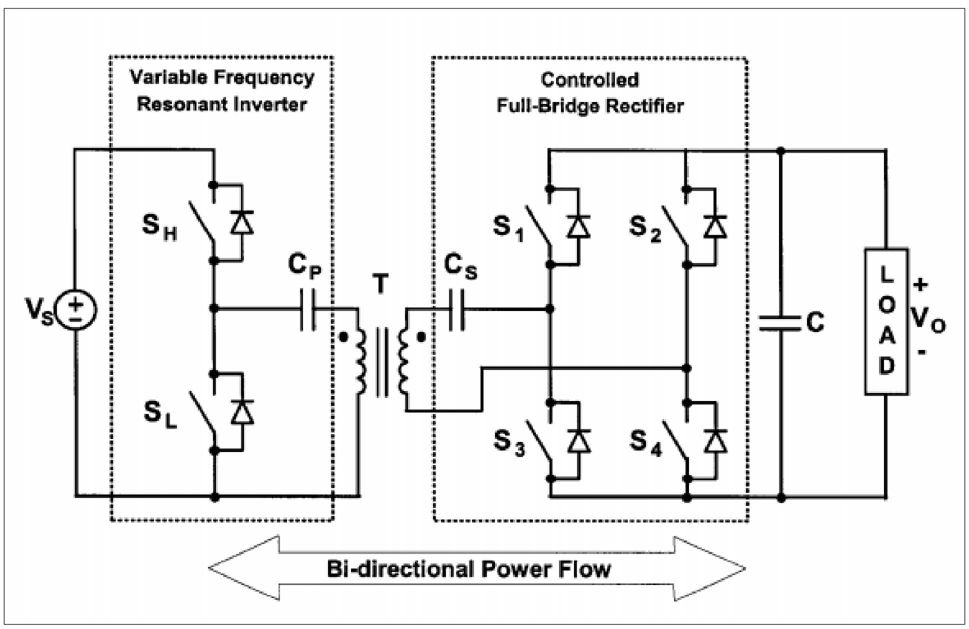
Finally, the transformer is an "isolating path" at least because *Jang* discloses there are "no connections between the input and output side" of the CEET system. (Ex. PA-1, 2:3-4; Ex. PA-DEC, ¶82.) For instance the path between the transformers of *Jang*'s Figures 9 and 10 are the electrically isolating paths across its transformers. (Ex. PA-1, FIG. 10.)

4. Claim 7

a. The apparatus as recited in claim 1 further comprising a power train including a first switching circuit coupled to said first metallic coil configured to form a portion of a resonant topology with a second switching circuit coupled to said second metallic coil.

Jang in view of *Brockmann* discloses or suggests the limitations of claim 7. (Ex. PA-DEC, ¶¶83-88.) *Jang* in view of *Brockmann* discloses the limitations of claim 1 as described above, including the secondary winding ("first metallic coil") and primary winding ("second metallic coil"). (*Supra* Section VII.A.3.)

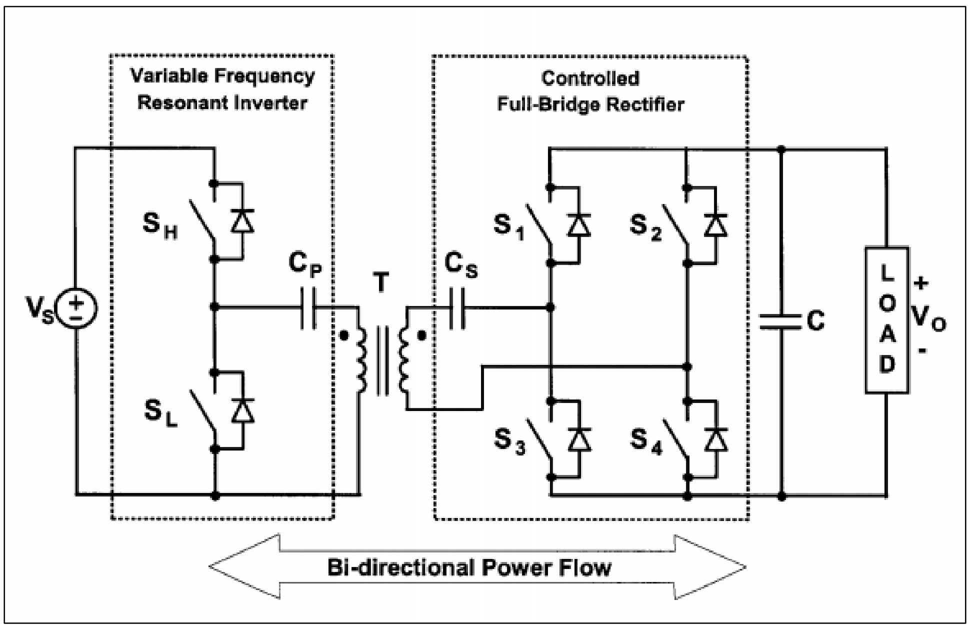
Jang in view of *Brockmann* discloses or suggests the apparatus "further comprising a power train including a first switching circuit coupled to said first metallic coil." For instance, *Jang* discloses a controlled rectifier ("a power train including a first switching circuit"), which can take the form of a controlled full-bridge rectifier shown in Figure 10, below, coupled to the first metallic coil. (Ex. PA-1, 7:5-13, FIG. 10.)



(*Id.*, Fig. 10.)

As shown in Figure 10, the controlled rectifier includes a switching circuit comprising four switches in a full-bridge configuration (S_1-S_4). (*Id.*, FIG. 10; Ex. PA-DEC, ¶84.) As further shown in Figure 10, the switches in the rectifier are coupled to the metallic coil. (Ex. PA-1, 7:8-37, FIG. 10.) Again, *Brockmann*'s coil and core structure and magnetic core piecepart configurations do not change how the *Jang* power train would operate (which connects the coil and core structure to a load).

Jang in view of *Brockmann* discloses or suggests the apparatus further comprising a power train including a first switching circuit coupled to said first metallic coil "configured to form a portion of a resonant topology with a second switching circuit coupled to said second metallic coil." For instance, *Jang* further discloses a variable frequency resonant inverter having switches S_H and S_L ("a second switching circuit") that is coupled to the second metallic coil, as shown in Figure 10, below.



(*Id.*, Fig. 10.)

Jang explains that "[t]o maximize the conversion efficiency by recovering the energy stored in relatively large inductances of the CEET transformer, the **variable-frequency inverter needs to be implemented with a resonant topology**." (*Id.*, 4:20-23 (emphasis added).) *Jang* describes the resonant inverter topology with respect to Figures 4 and 5, but the relevant topology is the same in the Figure 10 embodiment. (*Id.*, 4:20-54, FIGs. 4, 5, 10.)

For instance, *Jang* discloses that "[a]s an example, FIG. 4 shows the implementation of the CEET system of this invention with a series resonant inverter. The input power circuit is comprised of a pair of switches S_H and S_L, and a resonant capacitor C_P. The output load circuit is comprised of secondary switch S_S, a resonant capacitor C_S, a diode D and a filter capacitor C." (*Id.*, 4:34-39.) Moreover, *Jang* describes the circuit with reference to Figure 5 as a "series resonant circuit

. . . formed by capacitors C_P and C_S, and leakage inductances L_P and L_S.” (*Id.*, 4:34-54 (noting that the circuit in Fig. 4 and 5 are the same circuit).)

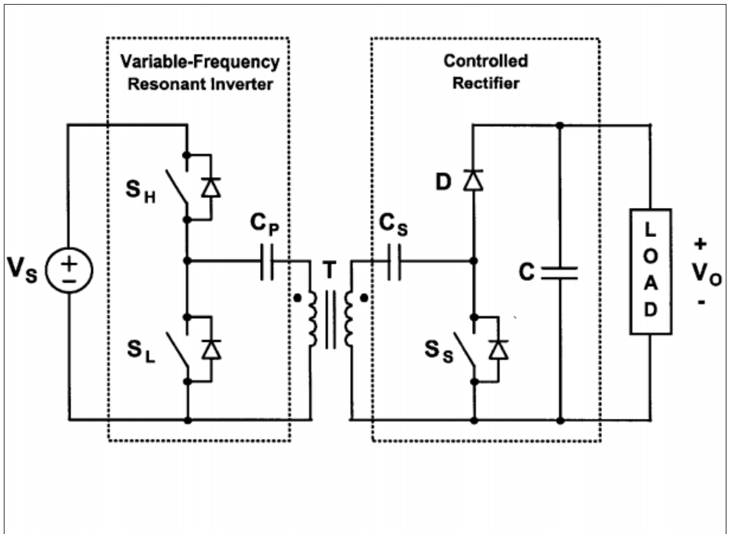
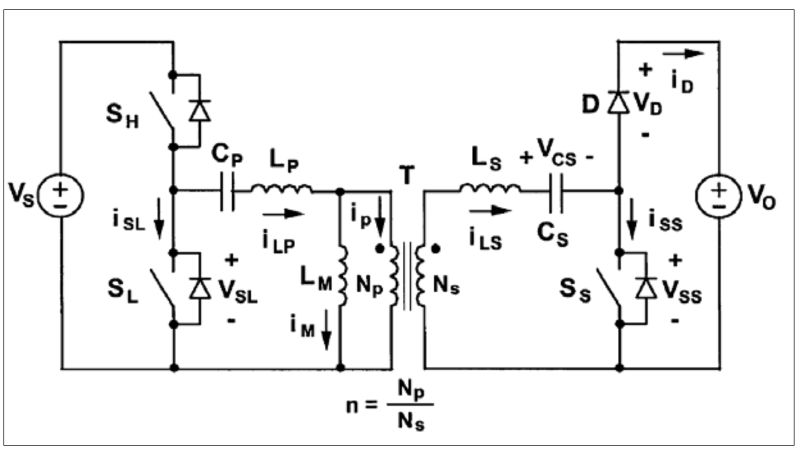
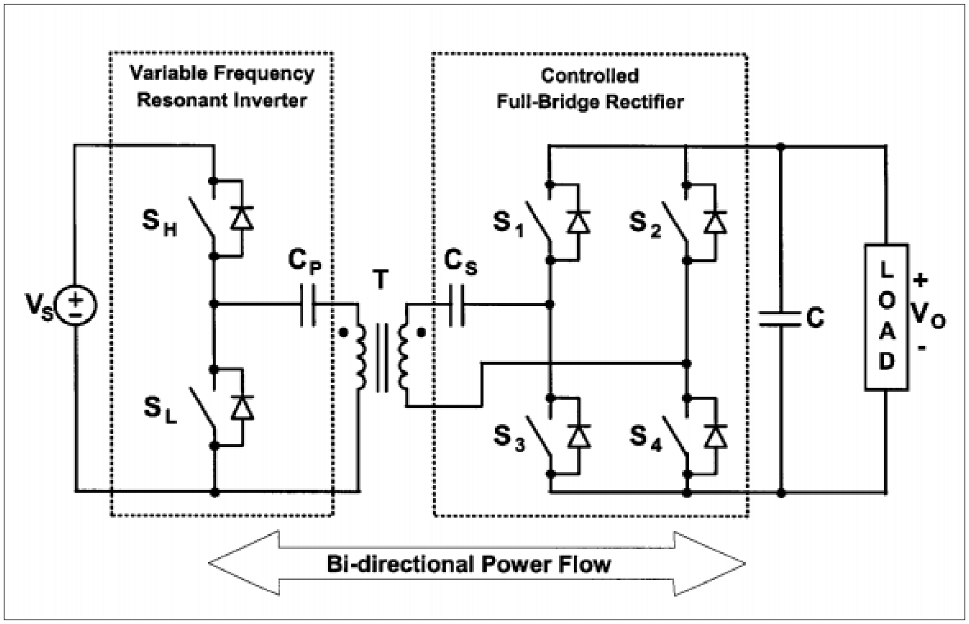


Fig. 4

(*Id.*, FIG. 4 (showing a variable-frequency resonant inverter and resonant capacitor C_S in the rectifier).)



(*Id.*, FIG. 5 (explicitly showing magnetizing and leakage inductances of the Figure 4 resonant circuit).)



(*Id.*, FIG. 10 (showing a variable-frequency resonant inverter and resonant capacitor C_S in the rectifier).)

Because *Jang*'s rectifier (including its "first" switching circuit) is configured as part of a resonant topology with the resonant inverter (including its "second" switching circuit), and resonant capacitors C_P and C_S, *Jang*'s power train is configured to form a portion of a resonant topology with the resonant inverter's switching circuit. (Ex. PA-DEC, ¶88.) Further, *Brockmann*'s coil and core structure and magnetic core piecepart configurations, *supra* Section VII.A.3, do not change how the *Jang* power train would operate at resonance. (*Id.*) Indeed, *Brockmann* discloses that its coils and core configurations are applicable to resonant circuits. Brockman stresses its wireless circuits also make it possible for "a transformer" to be "used for [a] resonance converter which is very low in volume and weight." (Ex. PA-2, 1:50-55, FIG. 2.) Thus, the *Jang*-*Brockmann* combination discloses or suggests the claimed resonance topology. (Ex. PA-DEC, ¶88.)

5. Claim 9

a. The apparatus as recited in claim 7 wherein said power train is configured to be intermittently operated in a burst mode of operation to control a characteristic of said battery.

Jang discloses or suggests the limitations of claim 9. (Ex. PA-DEC, ¶¶89-92.) Specifically, *Jang* discloses operating the resonant inverter switches "S_H and S_L" in a "burst" mode of operation. (Ex. PA-1, 6:66-7:4.) *Jang* discloses operating the power train with an "automatic restart, i.e., to turn off inverter switches S_H and S_L, for a pre-set period of time and then restarts the inverter." (Ex. PA-1, 6:66-7:4.) This "**burst**" or "hiccup" mode is used when the system detects a light load or a no-load condition ("intermittently operated in a burst mode"). (*Id.*, 6:55-7:4 (emphasis added).) Although Requester does not concede that the *Jang*'s resonant inverter switches (the "second switching circuit") are part of the power train, Patent Owner has argued that this claim encompasses *either* the first or second switching circuits, or any other components of the power train, configured to operate in a burst mode of operation. (Ex. EDTX-4, 32-33.)

Jang also discloses that the power train powers the load during a light load condition. (Ex. PA-1, FIG. 10 (illustrating the load of the wireless power circuit); *id.*, 6:66-7:4 (explaining that the burst mode powers a load during a light load condition); Ex. PA-DEC, ¶90.) As discussed for claim limitation 1[c], *supra* Section VII.A.3.c, the load is a battery. (Ex. PA-DEC, ¶90.) Because *Jang*'s burst mode would control a voltage and/or current characteristic of the load, *Jang* discloses the power train is configured to be intermittently operated in a burst mode to control a characteristic of the battery. (Ex. PA-1, FIG. 10, 6:66-7:4; *id.*, (explaining that the burst mode maximizes "light load" efficiency); Ex. PA-DEC, ¶90 (explaining that powering a load with a burst mode entails controlling the voltage or current of the load and that controlling a load efficiently controls the voltage or current characteristics of the load).)

Jang's disclosure is consistent with the District Court's construction of "burst mode of operation," *see supra* Section V, to mean "a mode of operation wherein the power train is periodically activated and deactivated" because as described above, the power train is intermittently activated and deactivated in the burst or hiccup mode when the system detects a light load or no-load condition. (Ex. PA-DEC, ¶91.)

Brockmann's coil and core structure and magnetic core piecepart configurations do not change how the *Jang* power train would operate (which can operate in the claimed burst mode). The *Brockmann* modifications, discussed in claim 1, change the efficiency of the system and do not prevent *Jang* from operating as described. (Ex. PA-DEC, ¶92; *see supra* Section VII.A.3.)

6. Claim 15

a. [15.a] A system, comprising:

To the extent the preamble is limiting, *Jang* discloses this limitation. (Ex. PA-DEC, ¶¶93-96.) For example, Figure 3 illustrates a contactless electrical energy transmission ("CEET") system. (Ex. PA-1, 3:43-56, 4:3-8, FIG. 3.)

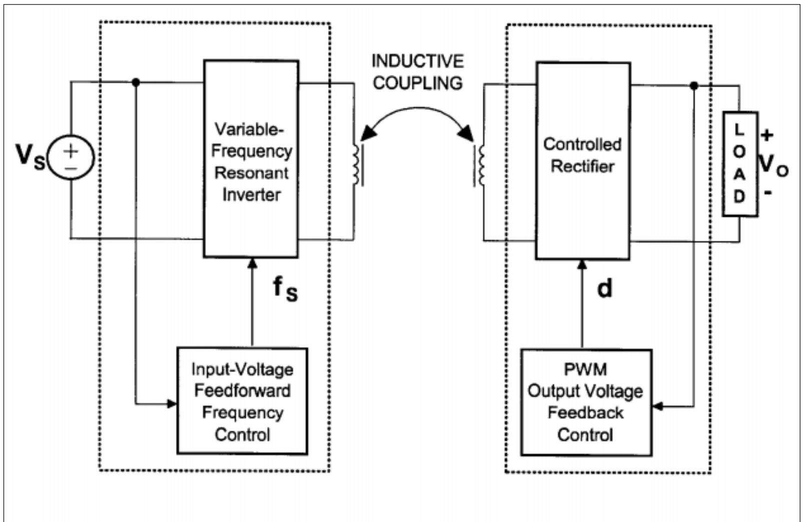


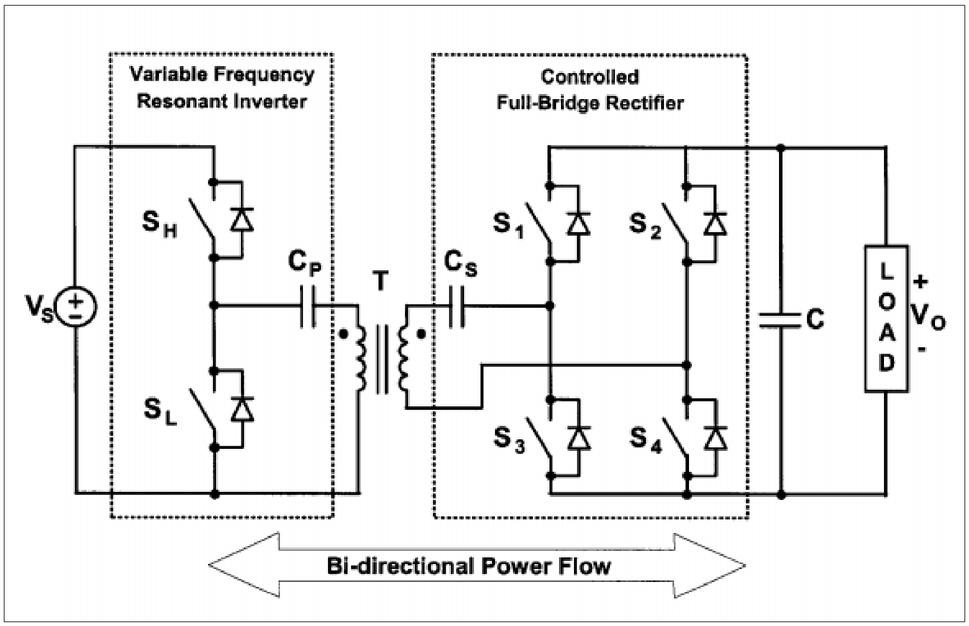
Fig. 3

(*Id.*, FIG. 3.)

Jang's CEET system transfers power wirelessly to and from a load through a transformer, where each side of the transformer is connected to a switching circuit. (*Id.*, Abstract, 4:4-5, FIGs. 3, 9, 10.) In the system, "a transformer provides the only coupling between the power transmitter and the power receiver." (*Id.*, 1:5-8.)

Jang describes multiple variations of the Figure 3 CEET system, where Figure 4 shows an implementation of the CEET system with a series resonant inverter, *id.*, 3:46-49, 4:34-36, (Figure 5 shows the same circuit as Figure 4 but where the circuit diagram includes leakage and magnetizing inductances of the transformer, *id.*, 3:50-53, 4:41-43), and Figures 9 and 10 show implementations of the same Figure 4/5 CEET system where the apparatus has a synchronous rectifier (a half-bridge rectifier) or a full-wave bi-directional rectifier (full-bridge rectifier), respectively, *id.*, 3:59-63, 7:5-14. The rectifiers in the apparatus of Figures 9 and 10 "allows bi-directional flow from the source to the load and vice-vers[a]." (*Id.*, 7:8-14 ("[T]he implementation in FIG. 9 allows bi-directional flow from the source to the load, and vice-vers[a], because both the inverter and the rectifier can conduct current in both directions. The CEET system with bidirectional power flow can be also implemented with full-wave bi-directional rectifier, as shown in FIG. 10.").)

The Figure 10 system is referred to herein, but generally Figures 9 and 10 can be considered interchangeably, because the only difference is the number of switches in the rectifier. (*Id.*, FIGs. 9-10, 7:5-13.)



(*Id.*, FIG. 10 (illustrating that the bidirectional power system may include a "full-bridge rectifier").)

b. [15.b] a wireless battery interface including a wireless battery interface magnetic core piecepart; and a wireless battery, including: a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer;

Jang in view of *Brockmann* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶97-99; *see also supra* Section VII.A.3.) Claim 15 largely tracks claim 1, except that it recites a system instead of an apparatus, and uses different nomenclature. As detailed below, the "wireless battery" refers to the circuit on the side of the transformer connected to a battery (claimed "wireless battery including . . . a battery"), and the "wireless battery interface" is on the other side of the transformer, and need not include a battery. (Ex. PAT-A, Claim 15; *see also id.*, 5:20-22 ("FIG. 2 illustrate[s] . . . a schematic diagram of an embodiment of a power system with a wireless battery 200 and a wireless battery interface 250.").)

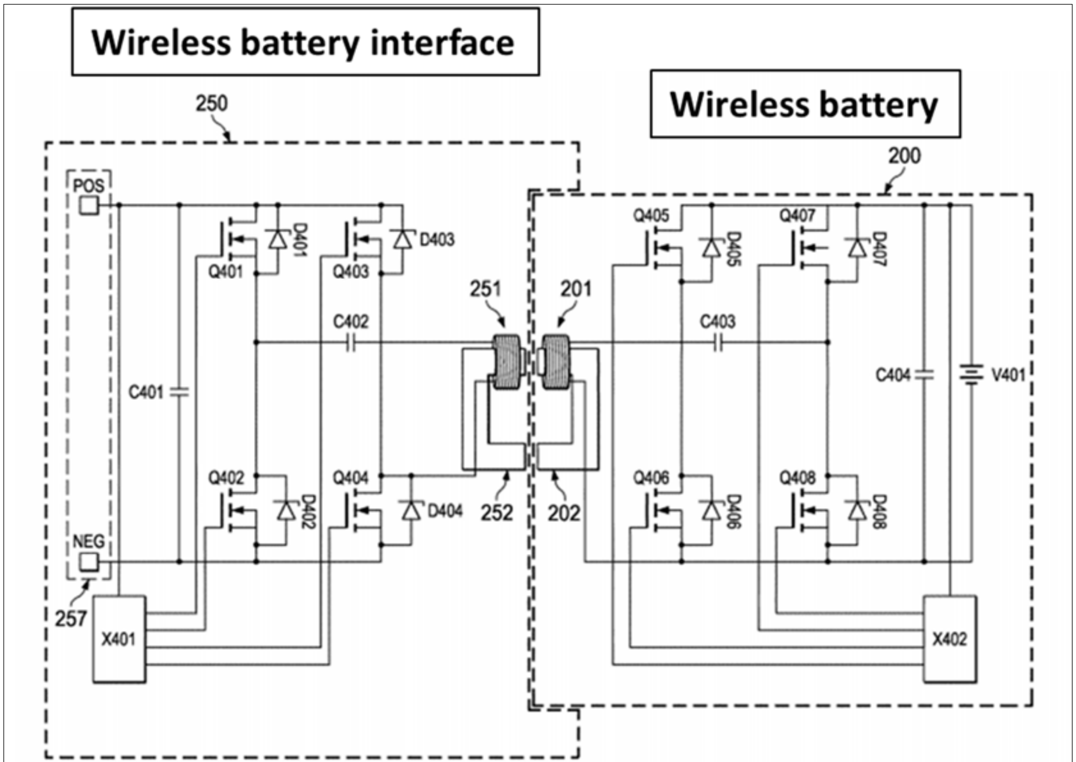
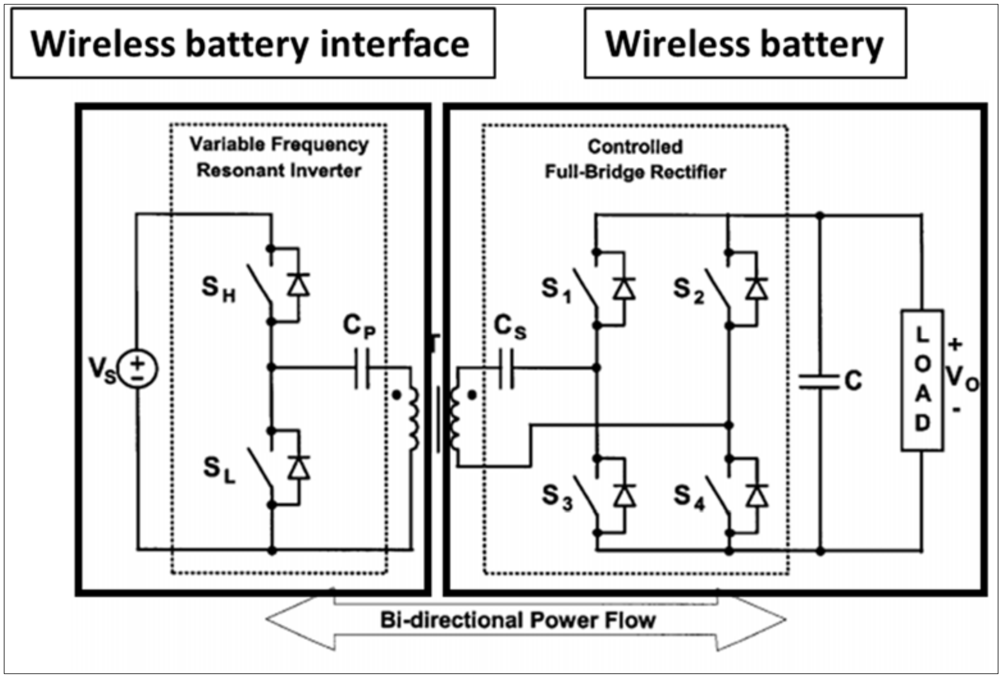


FIG. 2

(*Id.*, FIG. 2 (annotated); Ex. PA-DEC, ¶97.)

Jang discloses the claimed wireless battery interface and wireless battery. Annotated Figure 10 below provides an example, but this same nomenclature applies to *Jang*'s other figures and disclosures.



(Ex. PA-1, FIG. 10 (annotated).)

As described for claim elements 1[b] and 1[c], *supra* Section VII.A.3.b-c, *Jang* in view of *Brockmann* discloses or suggests these limitations. (Ex. PA-DEC, ¶98.) The Figure 10 load is a battery, *supra* Section VII.A.3.c, and this load is a part of the wireless battery as illustrated above. *Jang* in view of *Brockmann* discloses or suggests the claimed magnetic core pieceparts which are "configured to be coupled to, aligned with and removable from" each other. (*Supra* Section VII.A.3.b.) And as explained with respect to annotated Figure 10 above, each of the wireless battery interface and wireless battery includes a magnetic core piecepart as claimed to form the wireless transformer. (*Id.*, FIG. 10, 7:5-37; *supra* Section VII.A.3.b.)

Jang in view of *Brockman* discloses or suggests the "magnetic core piecepart" under both the District Court and Board's constructions for similar reasons as explained for claim 1, *supra* Section VII.A.3. (Ex. PA-DEC, ¶99.)

c. [15.c] a wireless battery, including: . . . a battery metallically coupled to a first metallic coil encircling at least a portion of said wireless battery magnetic core piecepart and configured to be charged and discharged through an electrically isolating path of said transformer.

Jang in view of *Brockmann* discloses or suggests these limitations. (Ex. PA-DEC, ¶100.) As discussed for claim elements 1[b], 1[c], and 15[b], *supra* Sections VII.A.3.b-c, VII.A.6.b, *Jang* discloses a first metallic coil (the inductor on the rectifier side of *Jang*'s transformer), with a battery (load) metallically coupled to the first metallic coil. And as discussed above for claim element 1[c], *supra* Section VII.A.3.c, the battery in *Jang*'s CEET system is configured to be charged and discharged through an electrically isolating path of *Jang*'s transformer (discussed in claim 1 with reference to the apparatus).

7. Claim 16

a. The system as recited in claim 15 further comprising a power train including a first switching circuit of said wireless battery configured to form a portion of a resonant topology with a second switching circuit of said wireless battery interface.

Jang and *Brockmann* disclose or suggest the limitations of claim 16 for the same reasons presented above for claims 7 and 15. (*See supra* Sections VII.A.4, 6; Ex. PA-DEC, ¶101.)

B. SNQ2: *Jang* in view of *Brockmann* and *Yang* Renders Obvious Claim 8

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Brockmann* and further in view of *Yang* discloses or suggests the limitations of claim 8 of the '067 patent. (Ex. PA-DEC, ¶¶102-115.)

1. Overview of *Yang*

Yang relates to a resonant power converter with half bridge and full bridge operations. (Ex. PA-3, Abstract ("A resonant power converter with half bridge and full bridge operations and a method for control thereof are provided.").) For instance, *Yang* discloses transistor switches 20, 25, 30, 35 as well capacitors 45 and 85, an inductive device 10, and rectifiers 81 and 82. (Ex. PA-3, FIG. 1, 2:24-40.) Together, these components form a power train that is used to convert voltages. (*Id.*, 2:24-40 ("FIG. 1 shows a power converter in accordance with a preferred embodiment of the present invention. . . . The switching frequency of the switching signals S_A, S_B, S_C, S_D is varied in accordance with a feedback signal VFB for regulating the output V_O.").)

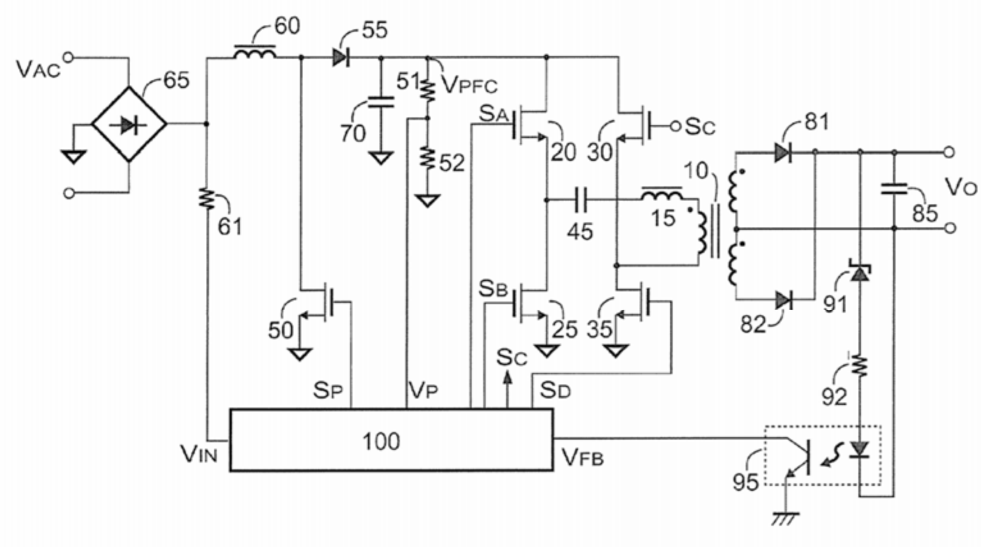


FIG. 1

(*Id.*, FIG. 1; *id.*, 2:24-33 ("FIG. 1 shows a power converter in accordance with a preferred embodiment of the present invention. A capacitor 45 and an inductive device (such as a transformer 10 and its parasitic inductor 15) develop a resonant tank. Transistor 20, 25 and 30, 35 develop a full bridge circuit to switch the resonant tank. Two rectifiers 81 and 82 are connected from the secondary winding of the transformer 10 to the output capacitor 85 for generating an output V, at the capacitor 85. A control circuit 100 generates switching signals [S subscripts] to control the transistors 20, 25, 30, 35 respectively.").)

Yang discloses that "[t]he full bridge circuit is operated as a full bridge switching when the input signal V_P is lower than a threshold. The full bridge circuit is operated as a half bridge switching when the input signal V_P is higher than the threshold." (*Id.*, 2:48-52.) Said differently, the power converter can switch between half and full bridge modes of operation. (*Id.*, 1:34-37, Abstract.) Control circuit 100 includes a detection circuit consisting of components 110, 120, 150, and 160 that is coupled to receive the line-voltage signal V_{IN} for generating a control signal MODE. (*Id.*, 3:4-7, FIG. 2.) When the input voltage is lower than a threshold, the control circuit 100 enables full bridge switching via the MODE signal. (*Id.*, 3:8-11 ("The control signal MODE will be generated to enable the full bridge switching once the line-voltage signal V_{IN} is lower than a threshold signal V_{T1}."); *id.*, FIG. 2.) Similarly, the "full bridge circuit is operated as a half bridge switching when the input signal V_P is higher than the threshold." (*Id.*, 2:48-52.)

Figure 2 illustrates how the control circuit 100 controls the full bridge and half bridge operation points. (*Id.*, FIG. 2; *id.*, 3:4 ("FIG. 2 is a preferred embodiment of the control circuit 100.").)

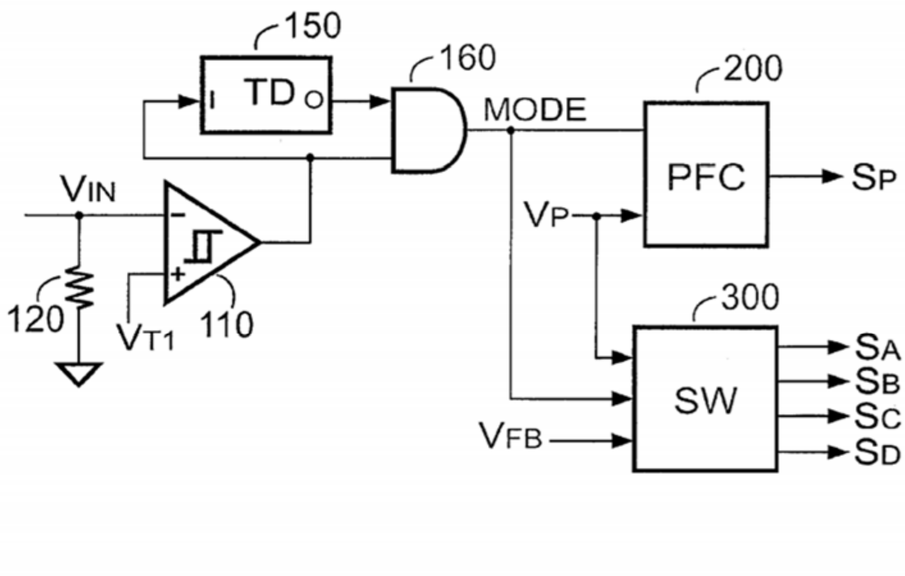


FIG. 2

(*Id.*, FIG. 2.)

Yang is in the same or similar technical field as *Jang* at least because, like *Jang*, *Yang* relates to power converter topologies. (Ex. PA-1, 1:53-55 (discussing "converter topologies" for use with a CEET transformer); *id.*, 6:1-10 (referring to the CEET system as the "proposed converter"); *id.*, 6:59 ("the converter"); Ex. PA-3, Abstract ("A resonant power converter with half bridge and full bridge operations and a method for control thereof are provided."); Ex. PA-DEC, ¶106.)

Yang is also in the same technical field as the '067 patent. (Ex. PAT-A, 17:52-54 ("[V]arious power converter topologies are well within the broad scope of the present invention."); *id.*, 3:23-24 ("The power system will be described as a switched-mode power supply or power converter."); *id.*, 4:37-41 ("The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by the metallic contact battery power systems.").) And *Yang* is reasonably pertinent to problems associated with power converter operating voltages and efficiency, problems with which the inventor was involved. (Ex. PA-3, 1:26-34 ("The drawback of the resonant power converter is its narrow operation range. It cannot be operated in a wide input voltage range. . . .

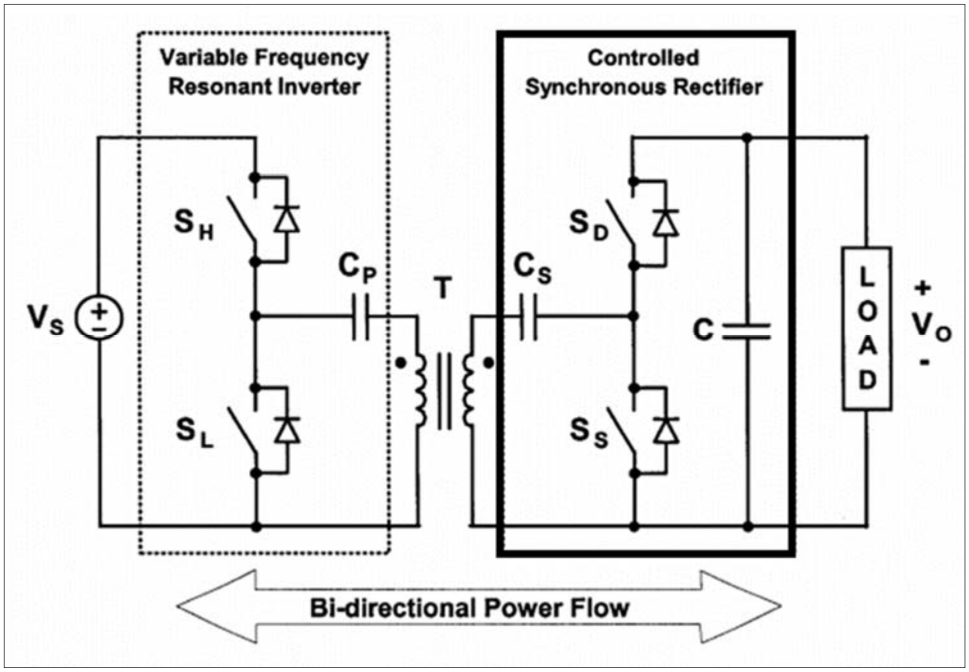
The object of the present invention is to provide a control scheme to solve this problem. It allows the resonant power converter can be operated in wide input range."); *id.*, 5:53-55 ("Therefore, a higher efficiency and wider operation range for the power converter are achieved."); Ex. PAT-A, 7:22-26 ("The controller X401 can therefore be configured to selectively cause at least a portion of the power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level (e.g., the voltage at the terminals 257)."); *id.*, 4:37-41 ("The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by the metallic contact battery power systems.").)

2. Claim 8

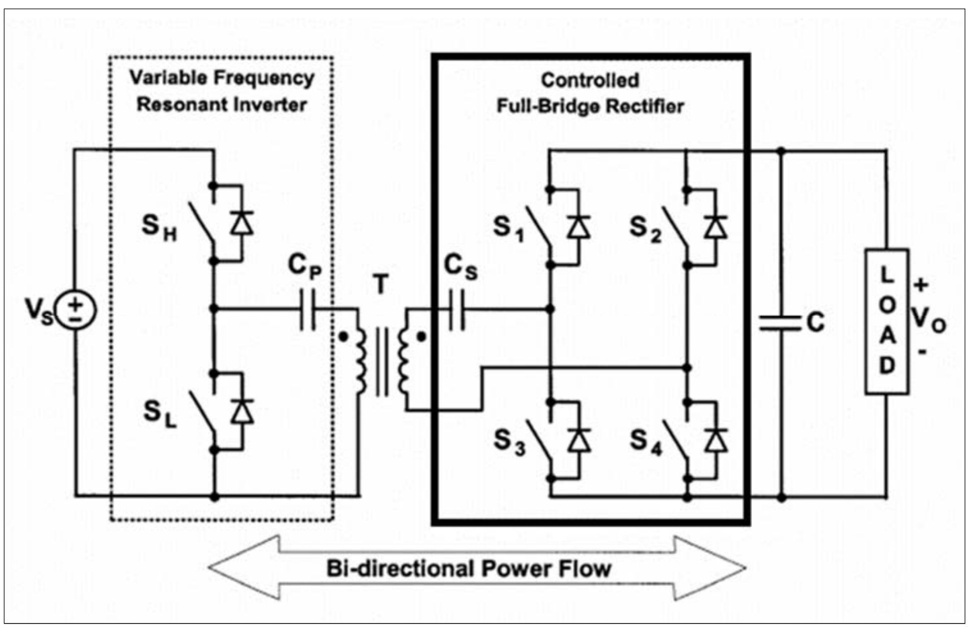
a. The apparatus as recited in claim 7 further comprising a controller configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level.

Jang in view of *Brockmann* and *Yang* discloses or suggest the limitations of claim 8. (Ex. PA-DEC, ¶¶109-115.) As discussed above, *Jang* in view of *Brockmann* and *Yang* discloses or suggests the limitations of claim 7. (*Supra* Section VII.A.4; Ex. PA-DEC, ¶109)

Jang further discloses with reference to Figures 9 and 10 that its CEET system with bi-directional power flow can be implemented having a synchronous rectifier (a half-bridge rectifier) or a full-wave bi-directional rectifier (full-bridge rectifier), respectively. (Ex. PA-1, 7:5-14; FIGs. 9, 10.) The rectifiers in the apparatus of Figures 9 and 10 "allows bi-directional flow from the source to the load and vice-vers[a]." (*Id.*, 7:8-14.)



(*Id.*, FIG. 9 (half-bridge rectifier in black box); Ex. PA-DEC, ¶110.)



(Ex. PA-1, FIG. 10 (full-bridge rectifier in black box); Ex. PA-DEC, ¶110.)

Although *Jang*'s apparatus can use either a half-bridge or full-bridge rectifier, it does not disclose that its controller is "configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level." However, it would have been obvious to a POSITA to modify *Jang* to include this feature in view of the teachings of *Yang*. (Ex. PA-DEC, ¶111.)

In a similar power converter art, *Yang* discloses a "resonant power converter with half bridge and full bridge operations and a method for control," where an "input signal is correlated to the input voltage of the full bridge circuit, where the **full bridge circuit is operated as a full bridge switching when the input signal is lower than a threshold, and the full bridge circuit is operated as a half bridge switching when the input signal is higher than the threshold**." (Ex. PA-3, Abstract (emphasis added); *see also id.*, 1:43-45 ("The control circuit coupled to receive a feedback signal and an input signal generates switching signals.").)

Like *Jang*'s Figure 10 embodiment, *Yang* discloses a power train that includes a full bridge circuit. (Ex. PA-DEC, ¶113.) For instance, *Yang* discloses transistor switches 20, 25, 30, 35 as well capacitors 45 and 85, an inductive device 10, and rectifiers 81 and 82. (Ex. PA-3, FIG. 1, 2:24-40.) Together, these components form a power train that is used to convert voltages. (*Id.*, 2:24-40 ("FIG. 1 shows a power converter in accordance with a preferred embodiment of the present invention. . . . The switching frequency of the switching signals S_A, S_B, S_C, S_D is varied in accordance with a feedback signal VFB for regulating the output V_O.").) Moreover, the transistor switches 20, 25, 30, and 35 form a conventional "full bridge circuit." (*Id.*, 2:24-29, FIG. 1.)

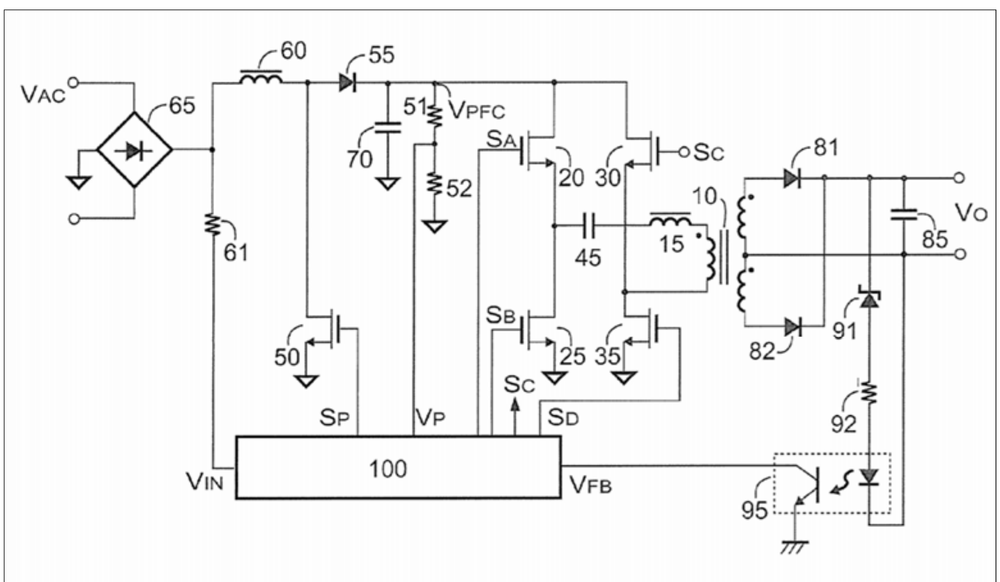


FIG. 1

(*Id.*, FIG. 1.)

Yang also discloses that the resonant power converter includes the full bridge circuit, a "control circuit and a PFC circuit" ("controller"). (*Id.*, 1:40-42; Ex. PA-DEC, ¶114.) And the control circuit is configured to switch the bridge circuit between operating in a full-bridge mode and a half-bridge mode based on a sensed voltage ("configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level"). (Ex. PA-3, 2:44-61, 3:4-12.) For instance, *Yang* discloses that the "control circuit [is] coupled to receive a feedback signal and an input signal generates switching signals. The feedback signal is correlated to an output of the power converter and the input signal is correlated to an input voltage of the full bridge circuit, where the full bridge circuit is operated as a full bridge switching when the input signal is lower than a threshold, and the full bridge circuit is operated as a half bridge switching when the input signal is higher than the threshold." (*Id.*, 1:40-52; *see also id.*, 2:44-61 ("The full bridge circuit is operated as a full bridge switching when the input signal VP is lower than a threshold. The full bridge circuit is operated as a half bridge switching when the input signal VP is higher than the threshold.").) Moreover, "[t]he full bridge circuit will operate the full bridge switching when its input voltage V_{PFC} is low. The half bridge switching will be performed when its input voltage V_{PFC}, is high. The PFC circuit is not necessary to produce a high output voltage when the line input voltage V_{AC}, is low. Therefore, a higher efficiency and wider operation range for the power converter are achieved." (*Id.*, 5:39-56.)

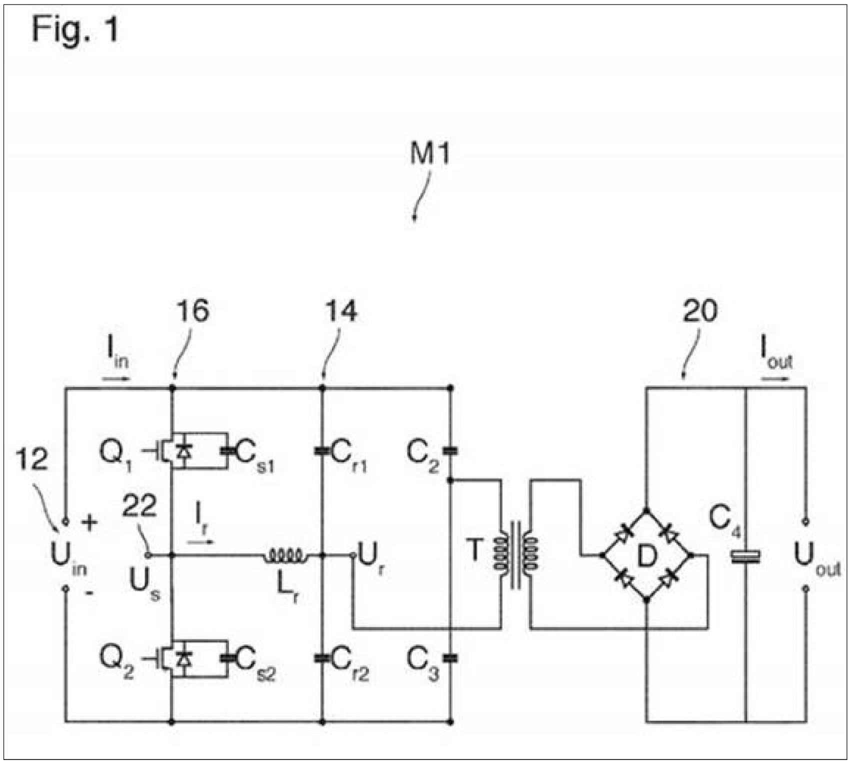
In view of the above disclosure of *Yang*, it would have been obvious, and POSITA would have been motivated, to use a controller to switch from a full-bridge to a half-bridge operation mode in *Jang*'s apparatus, as taught by *Yang*. (Ex. PA-DEC, ¶115.) Such an arrangement would have provided the benefit, disclosed by *Yang*, of achieving higher efficiency and a wider operation range for the power converter. (Ex. PA-3, 5:54-56; Ex. PA-DEC, ¶115.) Moreover, a POSITA would have recognized that using a controller to switch from full-bridge to half-bridge operation of *Jang*'s Figure 10 bridge circuit would be a combination of known prior art elements according to known methods to yield the predictable result of changing the switch circuit operating method in response to voltage fluctuating. (Ex. PA-DEC, ¶115.) Further, a POSITA would have had a reasonable expectation of success at least because *Jang* discloses that its rectifier can be configured to operate using either a full bridge or half bridge circuit for bi-directional power flow. (*Id.*; Ex. PA-1, 7:5-14; FIGs. 9, 10.) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

C. SNQ3: *Jang* in view of *Brockmann* and *Kardolus* Renders Obvious Claim 9

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Brockmann* and further in view of *Kardolus* discloses or suggests the limitations of claim 9 of the '067 patent. (Ex. PA-DEC, ¶116-128.)

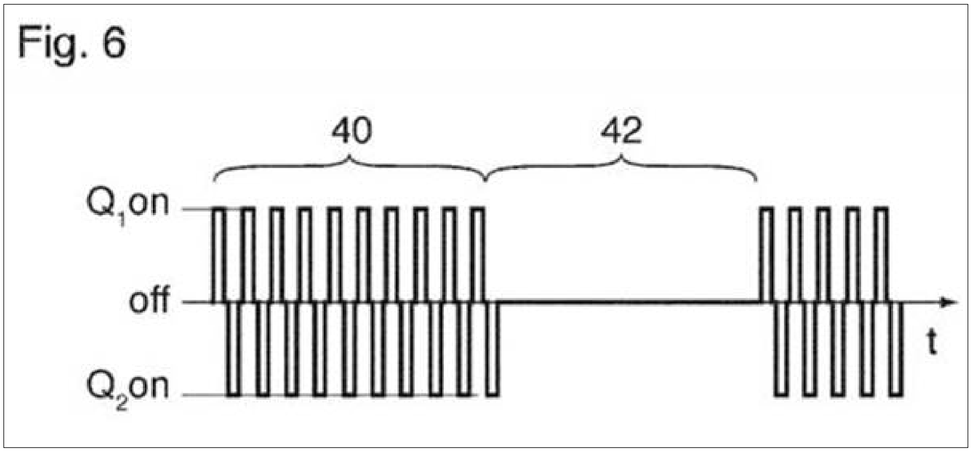
1. Overview of *Kardolus*

Kardolus relates to a battery charger for electric vehicles. (Ex. PA-4, ¶[0002].) The battery charger circuit includes a resonant power converter module and a bridge circuit and is illustrated in Figure 1. (*Id.*, ¶¶[0029]-[0033].)



(*Id.*, FIG. 1 (disclosing a circuit diagram of a resonant power converter module M1 used in a battery charger having a bridge circuit); *see also id.*, ¶[0029]-[0033].)

The *Kardolus* battery charger uses a "sequence of ON pulses of both switches [Q_1 and Q_2] is chopped into bursts 40 that are separated by breaks 42" ("power train is configured to be intermittently operated in a burst mode of operation") to "reduce the output current I_{out}." ("to control a characteristic of said battery"). (*Id.*, Abstract, ¶¶[0056]-[0058].) "In practice, the number of pulses per burst will be significantly larger than shown in FIG. 6, large enough for the resonance tank to tune-in, and the breaks 42 may be so large that the resonance oscillations may decay until the next burst begins. In this way, the power transfer may be reduced to 50% or even less." (*Id.*, ¶[0058].)



(*Id.*, FIG. 6.) *Kardolus* explains "it is also possible to combine [a] pulse skipping mode . . . with the burst mode of FIG. 6 in order to reduce the power transfer even further. Moreover it is possible to vary the ratio between the skipped and the non-skipped pulses in the pulse skip mode and/or to vary the ratio between the length of the bursts and the length of the breaks in the burst mode, and all this may additionally be combined with frequency control." (*Id.*, ¶[0059].)

Kardolus discloses the regulation of a characteristic (current) of a battery. (*Id.*, ¶[0059] ("when switching from one mode to another, the converter frequency may be set to a pre-defined value, based on a frequency table or a suitable algorithm, so as to prevent a momentary step in the output current during the transition."); *id.*, ¶[0073]-[0077] ("When the limit of the skip mode has been reached, the board controller 50 switches the module M3 to the burst mode shown in FIG. 6 and symbolized by an area 102 in FIG. 10. Again, the switching frequency is set back to the resonance frequency and then gradually increased again so as to further decrease the discharge current. When, with further decreasing demand I_t, the switching frequency has reached its maximum, the switching frequency of the module M2 is increased and the current share of the second module M2 is reduced (slope 104 in FIG. 4). When the current demand has become so low that it can be fulfilled by the two modules Ml and M2 alone, the module M3 is disabled. Both modules will operate at full power and with highest efficiency. As the demand signal I_t, decreases further, the procedure described above is repeated for the module M2 and finally for the module Ml. When the minimum I_{min} of the demand signal I_t, is reached, the module Ml, the only module that is still operating, is in the burst mode, and the switching frequency has been raised to the maximum. In this way, the converter unit Bl operates with the highest possible efficiency for any given current demand.").)

2. Claim 9

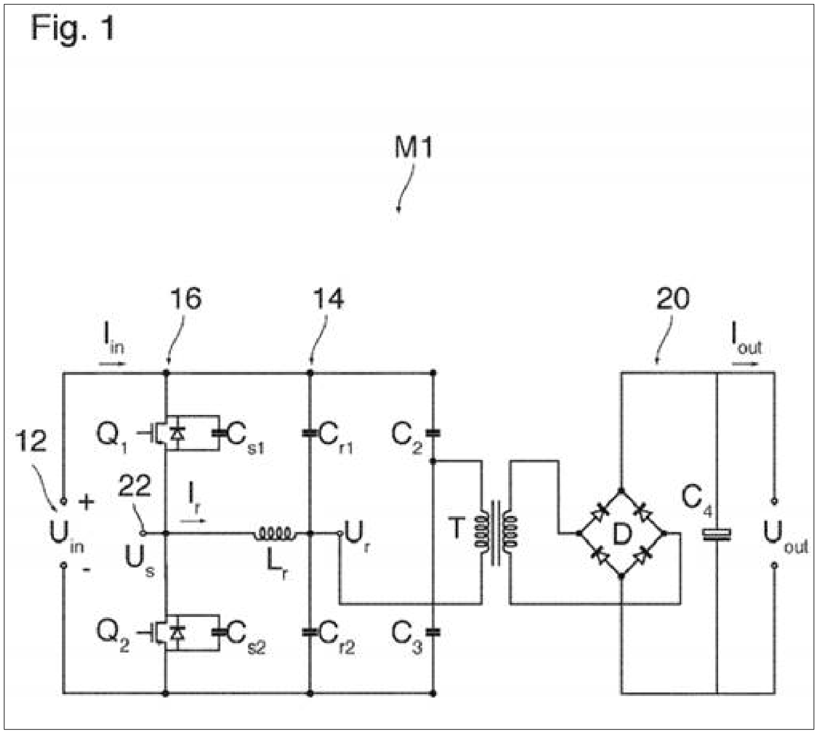
a. The apparatus as recited in claim 7 wherein said power train is configured to be intermittently operated in a burst mode of operation to control a characteristic of said battery.

Jang in view of *Brockmann* and *Kardolus* discloses or suggests the limitations of claim 9. (Ex. PA-DEC, ¶¶120-128.) As discussed above, *Jang* in view of *Brockmann* discloses or suggests the features of claim 7. (*Supra* Section VII.A.4.)

Jang further discloses or suggests an apparatus wherein the battery is charged and discharged through the power train, and specifically through the first switching circuit connected to the first metallic coil. (*See supra* Sections VII.A.3, 4; Ex. PA-DEC, ¶121.) *Jang* further discloses operating the resonant inverter switches "S_H and S_L" in a "burst" mode of operation. (Ex. PA-1, 6:66-7:4; *see also supra* Section VII.A.5.) To the extent *Jang*'s "burst" mode does not disclose or suggest the claimed "burst mode," it would have been obvious to a POSITA to modify *Jang* to include this limitation in view of the teachings of *Kardolus*. (Ex. PA-DEC, ¶121.)

Kardolus discloses a "battery charger for electric vehicles," including a "power converter module," (Ex. PA-4, Abstract, ¶[0007]), in which a "sequence of ON pulses of both switches [Q_1 and Q_2] is chopped into **bursts** 40 that are **separated by breaks** 42" ("power train is configured to be intermittently operated in a burst mode of operation") to "reduce the output current I_{out}" ("to control a characteristic of said battery"). (*Id.*, Abstract, ¶¶[0056]-[0058] (emphasis added).)

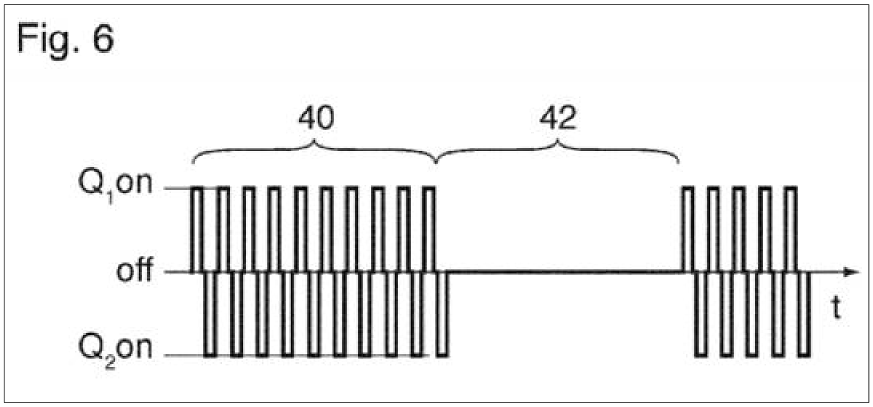
The battery charger of *Kardolus* is shown in Figure 1. (*Id.*, FIG. 1.)



(*Id.*, FIG. 1.)

The resonant power converter M1 in Figure 1 "is arranged to convert an input voltage U_{in} into a DC output voltage U_{out}, which will be equal to the battery voltage" (for a corresponding battery load). (*Id.*, ¶[0030].) The switches Q_1 and Q_2 form half bridge 16, and are opened and closed at a given frequency to generate voltage U_r, which "drives the primary side of a transformer T." (*Id.*, ¶¶[0031]-[0034].) The switching frequency of switches "Q1 and Q2 is varied in order to comply with varying demands for output current I_{out}." (*Id.*, ¶[0045].) For example, the switching frequency is increased to reduce the output current I_{out}. (*Id.*, ¶[0056].) However, if the switching frequency is increased too much (to generate a low output current I_{out}), "a point will be reached where the switching frequency must be so high that . . . the residual switching losses would become predominant." (*Id.*)

As a solution to the problem of predominant residual switching losses, *Kardolus* discloses operating the switches in a "burst" mode of operation. (*Id.*, ¶¶[0056]-[0058].) *Kardolus* describes this "mode of operation, wherein the sequence of ON pulses of both switches [Q_1 and Q_2] is chopped into bursts 40 that are separated by breaks 42.") (*Id.*, ¶[0058].) "In this way, power transfer may be reduced to 50% or even less," ensuring that "the resulting ripple in output current will be negligible." (*Id.*) The switching sequence of the "burst" "mode of operation" is shown in Figure 6.



(Ex. PA-4, FIG. 6.)

In view of the above disclosures of *Kardolus*, it would have been obvious, and a POSITA would have been motivated, to configure *Jang*'s power train to operate in a burst mode of operation where the sequences of on pulses of its switches are chopped into bursts and separated by breaks. (Ex. PA-DEC, ¶126.) As *Kardolus* teaches, a burst mode of operation is useful to reduce the power output from the switching circuit while preventing switching losses from becoming predominant. (Ex. PA-4, ¶[0058].) A POSITA would have recognized that such a problem would also occur in *Jang*'s switching circuits, when, like in *Kardolus*, the power transmitted through the switching circuit is decreased to an amount below what is efficient to transfer through a normal switching mode. (Ex. PA-DEC, ¶126.)

As the switching circuit of *Jang*'s power train is used to charge and discharge a battery through a transformer, *see supra* Sections VII.A.3-4, implementing a burst mode to decrease output current and improve efficiency in *Jang*'s power train would also control a characteristic of *Jang*'s battery (*e.g.,* the current output from the switching circuit of the power train to the battery). (Ex. PA-DEC, ¶127.)

A POSITA would have had a reasonable expectation of success in such an implementation, as the proposed modification would have combined known technologies (e.g., *Jang*'s known wireless power converter with a switching circuit) according to known methods (e.g., operating a switching circuit in a burst mode to control the output) to yield the predictable result of intermittently operating the power train in a burst mode to control a characteristic of the battery. (Ex. PA-DEC, ¶¶128.) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Jang in view of *Brockmann* and *Kardolus* discloses or suggests the "burst mode of operation" as construed by the District Court, *see supra* Section V, to mean "a mode of operation wherein the power train is periodically activated and deactivated" because as described above, a POSITA would have found it obvious to configure *Jang*'s power train to operate in a burst mode of operation, as taught by *Kardolus*, so that the sequences of on pulses of its switches are separated by breaks, i.e., periodically activated and deactivated. (Ex. PA-DEC, ¶128.)

D. SNQ4: *Jang* in view of *Brockmann* and *Lee* Renders Obvious Claims 10 and 11

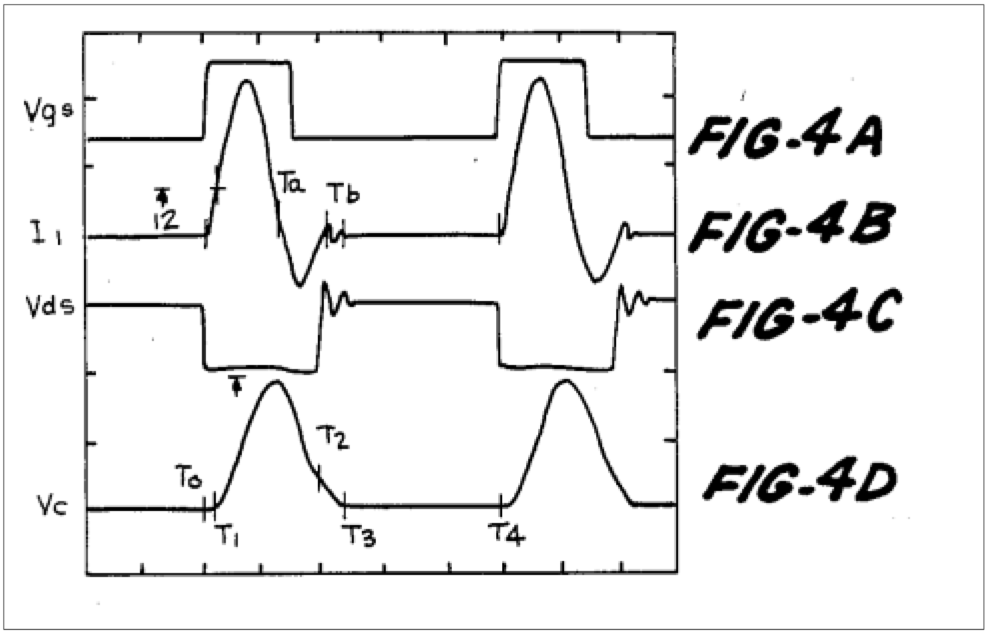
As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Brockmann* and further in view of *Lee* discloses or suggests the limitations of claims 10 and 11 of the '067 patent. (Ex. PA-DEC, ¶¶129-143.)

1. Overview of *Lee*

Lee relates to switching converters adapted to switch at relatively high frequencies and, in particular, to such converters that achieve switching on and off at zero current level, whereby high efficiency at such high frequencies is achieved. (Ex. PA-6, 1:8-12).

Lee teaches a family of quasi-resonant converters, "employing switches that turn on and off at zero current conditions." (Ex. PA-6, 3:38-44.) Specifically, *Lee* discloses "**[t]he impedances of the resonant capacitor and the resonant inductor are selected** to establish a resonating current waveform on the resonant inductor **to apply zero-current conditions to the switch at turn on" and turn off** ("a capacitor selected to produce substantially zero-current switching . . . in conjunction with an inductor"). (Ex. PA-6, 3:66-4:14 (emphasis added); *see also id.*, Abstract.)

Lee further discloses that "the impedances of the resonant capacitor and the resonant inductor are selected . . . to ensure that the current waveform imposed on the switch by the resonant inductor is at substantially zero current, when the switch is next disposed to its second or off state." (*Id.*, 4:5-11.) Typical waveforms of the forward buck quasi-resonant converter circuit are illustrated in FIGS. 4A, 4B and 4C. "The zero current switching property is evidenced by examining the current and voltage wave forms, i.e. the input current I_1 is zero when either the transistor Q_1 or the anti-parallel diode D_1 turns off and on. Also, energy is transferred to the output in a packet, whereby voltage regulation can be achieved by varying the turn-on repetition rate, i.e. the switching frequency F_s of the transistor Q_1." (*Id.*, 7:52-61.)



(*Id.*, FIG. 4.)

Lee discloses that one difference between its converter design and a prior art converter is that the switch "and diode are coupled in anti-parallel with each other to form a parallel circuit, which is in turn connected to the resonant inductor and the resonant capacitor." (Ex. PA-6, 4:15-25, 4:31-39.)

2. Claim 10

a. The apparatus as recited in claim 7 further comprising a capacitor selected to produce substantially zero-current switching of said first switching circuit in said power train in conjunction with an inductor.

Jang in view of *Brockmann* and *Lee* discloses or suggests the limitations of claim 10. (Ex. PA-DEC, ¶¶134-141.) As discussed above, *Jang* in view of *Brockmann* teach the elements of claim 7. (*See supra* Section VII.A.4; Ex. PA-DEC, ¶134.)

Jang further discloses that resonant capacitor C_S, (Ex. PA-1, Fig. 10, 4:37-39), operation at a frequency below resonance "offers zero-current switching," (*id.*, 6:25-30), and states that "soft-switched topologies are the optimal choice in CEET applications," (*id.*, 1:51-58). To the extent *Jang* does not explicitly disclose "a capacitor selected to produce substantially zero-current switching of said first switching circuit in said power train in conjunction with an inductor," it would have been obvious to a POSITA to modify *Jang* to implement such features in view of *Lee*. (Ex. PA-DEC, ¶135.)

In a similar power converter art, *Lee* teaches a family of quasi-resonant converters, "employing switches that turn on and off at zero current conditions." (Ex. PA-6, 3:38-44.) Specifically, *Lee* discloses "**[t]he impedances of the resonant capacitor and the resonant inductor are selected** to establish a resonating current waveform on the resonant inductor **to apply zero-current conditions to the switch at turn on" and turn off** ("a capacitor selected to produce substantially zero-current switching . . . in conjunction with an inductor"). (Ex. PA-6, 3:66-4:14 (emphasis added); *see also id.*, Abstract.) *Lee* further discloses that "the **impedances of the resonant capacitor and the resonant inductor are selected** . . . to ensure that the current waveform imposed on the switch by the resonant inductor is at **substantially zero current**, when the switch is next disposed to its second or off state." (*Id.*, 4:5-11 (emphasis added).)

In view of the above disclosure of *Lee*, it would have been obvious, and a POSITA would have been motivated, to select a capacitor to produce substantially zero-current switching in *Jang*'s power converter switching circuit (the "first switching circuit"). (Ex. PA-DEC, ¶137.) As *Lee* explains, zero current switching "eliminate[s] switching stresses and losses," and overcomes a problem with the prior art where "the DC voltage conversion ratio is sensitive to load variations." (Ex. PA-6, 3:31-51.) A POSITA would have understood that these benefits would have applied equally to *Jang*'s converter topology, and indeed would have understood that eliminating switching stresses and losses would be beneficial to any converter. (Ex. PA-DEC, ¶137.)

Additionally, a POSITA would have recognized that *Jang* already uses a resonant converter having a topology similar to those contemplated by *Lee*. (*Id.*, ¶138.) For example, *Lee* discloses that one difference between its converter design and a prior art converter is that the switch "and diode are coupled in anti-parallel with each other to form a parallel circuit, which is in turn connected to the resonant inductor and the resonant capacitor." (Ex. PA-6, 4:15-25, 4:31-39.) *Jang* discloses the same configuration. (Ex. PA-1, FIG. 10 (showing antiparallel diodes connected in parallel with switches S_1-S_4, and connected to resonant capacitor C_S and the inductor of the transformer T).)

Moreover, *Jang* already discloses zero current switching, as described above (Ex. PA-1, 1:51-58, 6:25-30), and thus *Lee* would merely inform a POSITA how to implement such a feature. (Ex. PA-DEC, ¶139.)

A POSITA would have had a reasonable expectation of success in the combination, even if such a combination required modification of *Jang*'s resonant converter. (*Id.*, ¶140.) Such a modification would have been well within the level of skill of a POSITA. (*Id.*, ¶140.) And *Jang* discloses a resonant converter where "any resonant topology can be employed." (Ex. PA-1, 4:23-24.)

Combining *Jang*'s power converter topology that is capable of performing zero current switching, as *Jang* discloses, with *Lee*'s teaching of selecting a capacitor and inductor to effect zero current switching together would have been nothing more than combining known prior art element according known methods to yield the predictable result of substantially zero current switching. (Ex. PA-DEC, ¶141.)

3. Claim 11

a. The apparatus as recited in claim 10 wherein said inductor is formed at least in part with said first metallic coil.

Jang in view of *Brockmann* and *Lee* discloses or suggests the limitations of claim 10. (*See supra* Section VII.D.2; Ex. PA-DEC, ¶141.)

As described for claim element 1[b], *Jang* discloses an apparatus having a first metallic coil. (*See supra* Section VII.A.3.b.) That metallic coil is the only inductor on the rectifier-side of *Jang*'s Figure 10 embodiment, where the first switching circuit is located. (Ex. PA-1, FIG. 10). Thus, *Jang* discloses that the inductor is the first metallic coil. (Ex. PA-DEC, ¶142.)

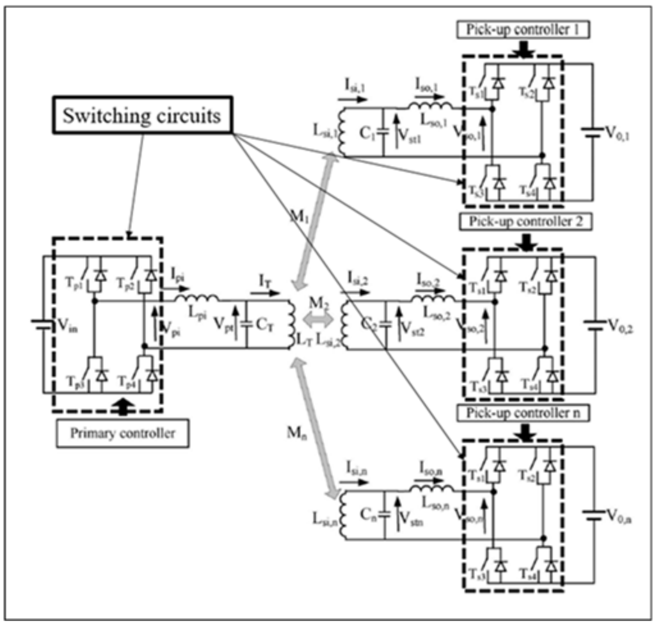
E. SNQ5: *Jang* in view of *Brockmann* and *Madawala* Renders Obvious Claims 12 and 17

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Brockmann* and further in view of *Madawala* discloses or suggests the limitations of claims 12 and 17 of the '067 patent. (Ex. PA-DEC, ¶¶143-160.)

1. Overview of *Madawala*

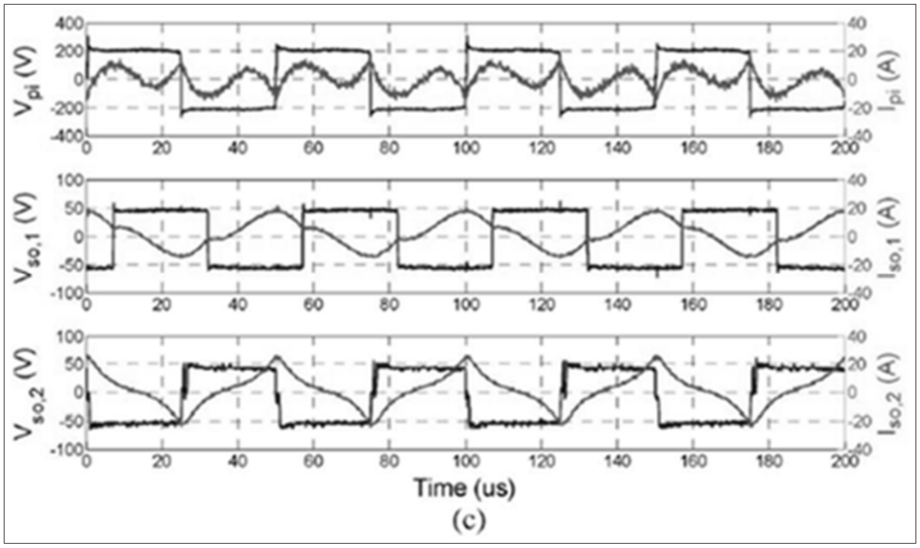
Madawala discloses a bidirectional wireless power circuit. (Ex. PA-11, 4790 ("This paper proposes a novel current-sourced bidirectional IPT power interface, which is suitable for simultaneous contactless/discharging of multiple EVs or equipment."); *id.*, Abstract ("Demand for supplying contactless or wireless power for various applications, ranging from low-power biomedical implants to high-power battery charging systems, is on the rise. Inductive power transfer (IPT) is a well-recognized technique through which power can be transferred from one system to another with no physical contacts. This paper presents a novel bidirectional IPT system.").)

In Figure 3, *Madawala* discloses a power train comprising switching circuits as well as various capacitive and inductive elements. (*Id.*, FIG. 3.) The power train is used to charge/discharge a variety of battery loads. (*Id.*, 4793 ("[T]he output power of the pickups in this case is regulated as required to charge or discharge the batteries of EVs.").)

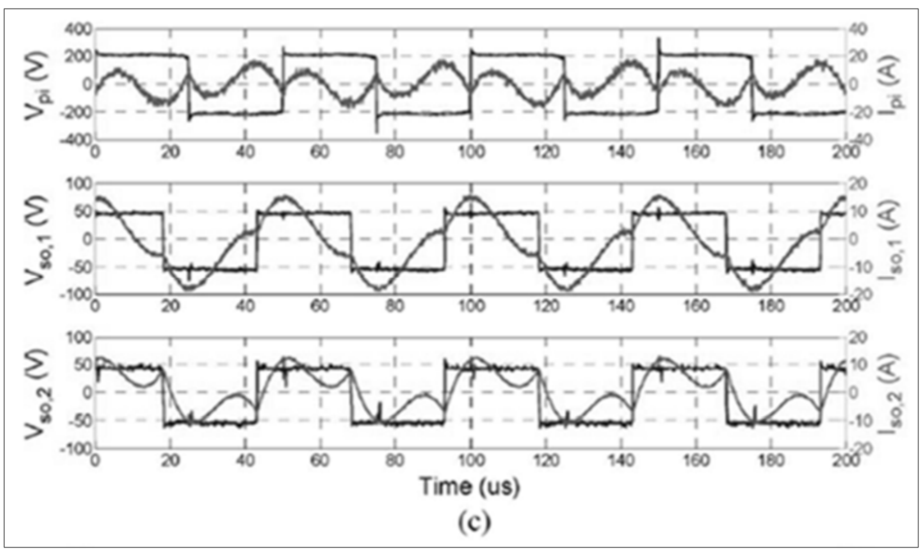


(*Id.*, FIG. 3 (illustrating various switching circuits of the *Madawala* power system).)

Madawala discloses that a change in the relative phase of a voltage of the power train can switch the system between charging and discharging. (*Id.*, 4790 (emphasis added) ("**[D]irection of power flow** between EVs or equipment and the grid can be **controlled through** either relative **phase** or/and magnitude **modulation of voltages generated by each converter**."); *id.*, 4792 ("A leading phase angle constitutes power transfer from the pickup to the track or primary, while a lagging phase angle enables power transfer from the track to the pickup. Thus, for any given primary and pickup voltages, both the amount and direction of power flow between the track and the pickup can be regulated by controlling the relative phase angle between voltages generated by primary and pickup reversible rectifiers.") Further, *Madawala* illustrates that a constant 50% duty cycle of the power train can be used to charge and discharge the wireless battery system.



(*Id.*, FIG. 9 (illustrating that power train voltages V_{pi}, $V_{so,1}$, or $V_{so,2}$ (the square waves) can be used in a charge mode at 50% duty cycles); *id.*, 4794 ("Fig. 9 shows the comparison between the simulated and measured waveforms in a situation where the primary delivers approximately 600 W to pickup 1 while pickup 2 idles.").)



(*Id.*, FIG. 10 (illustrating that power train voltages V_{pi}, $V_{so,1}$, or $V_{so,2}$ (the square waves) can be used in a discharge mode at 50% duty cycles); *id.*, 4795 ("Fig. 10 shows the waveforms of the system during the reverse power flow. In this situation, both pickups supply approximately 600 W to the primary. The voltages generated by both pickup-side converters are clearly leading the voltage that is produced by the primary side converter, and hence, the power flow is from the pickup side to the primary.").)

2. Claim 12

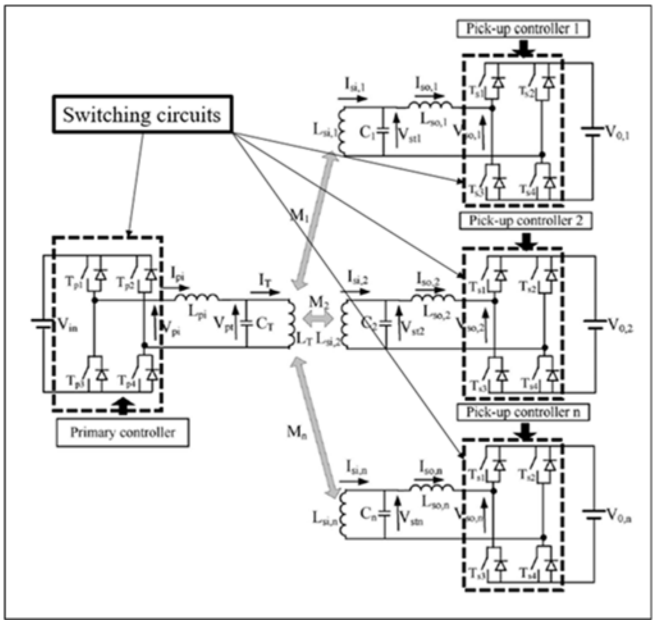
a. The apparatus as recited in claim 7 wherein said power train is configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit.

Jang in view of *Brockmann* and *Madawala* discloses or suggests the limitations of claim 12. (Ex. PA-DEC, ¶¶148-156.) As discussed above, *Jang* in view of *Brockmann* teach the elements of claim 7. (*See supra* Section VII.A.4; Ex. PA-DEC, ¶148.) And as discussed above for claim element 1[c], *Jang* discloses an apparatus configured to enable a battery to be charged and discharged through a transformer. (*Supra* Section VII.A.3.c; Ex. PA-DEC, ¶148.)

While *Jang* does not explicitly disclose that the power train is configured to enable said battery to be "successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit," it would have been obvious to a POSITA to modify *Jang* to implement such features in view of *Madawala*. (Ex. PA-DEC, ¶¶149.)

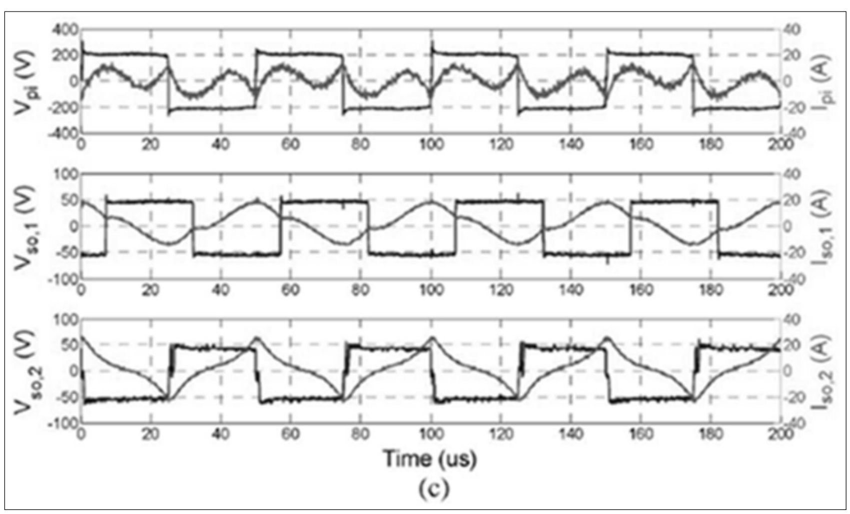
Madawala generally relates to "a bidirectional inductive power interface," and inductive power transfer, like *Jang*. (Ex. PA-11, 4790 ("This paper proposes a novel current-sourced bidirectional IPT power interface, which is suitable for simultaneous contactless/discharging of multiple EVs or equipment."); *id.*, Abstract ("Demand for supplying contactless or wireless power for various applications, ranging from low-power biomedical implants to high-power battery charging systems, is on the rise. Inductive power transfer (IPT) is a well recognized technique through which power can be transferred from one system to another with no physical contacts. This paper presents a novel bidirectional IPT system.").) Thus, like *Jang*, *Madawala* relates to transferring power wirelessly between devices, and a POSITA would have been interested in considering the teachings of *Madawala* when implementing *Jang*. (Ex. PA-DEC, ¶150.)

Also like *Jang*, *Madawala*'s bi-directional apparatus is configured to transfer power across a transformer, using switching circuits on each side of the transformer.



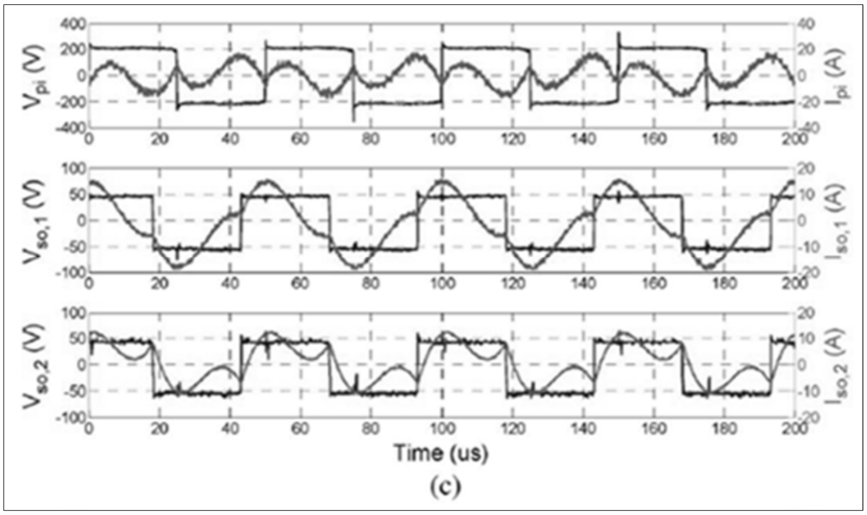
(Ex. PA-11, FIG. 3 (illustrating various switching circuits of the *Madawala* power system).)

Madawala discloses a constant 50% duty cycle of the power train used to charge and discharge the wireless battery system in its Figures 9, 10, and 11. (*Id.*, FIGs. 9, 10, 11.) In Figure 9, the pick-up circuit 1 (of Figure 3) receives power from the primary controller. (*Id.*, 4974.) In Figure 10, pickups 1 and 2 deliver power to the primary. (*Id.*) And in Figure 11, pickups 1 and 2 receive power from the primary. (*Id.*, 4975.) Each of the square waveforms shown in the figures has a duty cycle of approximately 50%. Figures 9 and 10 are excerpted below.



(*Id.*, FIG. 9 (illustrating that power train voltages V_{pi}, $V_{so,1}$, or $V_{so,2}$ (the square waves) can be used in a charge mode at 50% duty cycles); *id.*, 4794 ("Fig. 9 shows the comparison between the simulated and measured waveforms in a situation where the primary delivers approximately 600

W to pickup 1 while pickup 2 idles. The top two plots in Fig. 9 are the simulated results, and the bottom two plots show the measured waveforms.").)



(*Id.*, FIG. 10 (illustrating that power train voltages V_{pi}, $V_{so,1}$, or $V_{so,2}$ (the square waves) can be used in a discharge mode at 50% duty cycles); *id.*, 4795 ("Fig. 10 shows the waveforms of the system during the reverse power flow. In this situation, both pickups supply approximately 600 W to the primary. The voltages generated by both pickup-side converters are clearly leading the voltage that is produced by the primary side converter, and hence, the power flow is from the pickup side to the primary.").)

Madawala further discloses that by changing the relative phase of a voltage of the power train (i.e., without changing a duty cycle), it can reverse the direction of power flow and change between charging and discharging. (*Id.*, 4790 (emphasis added) ("[B]oth amount and **direction of power flow** between EVs or equipment and the grid can be **controlled through** either relative **phase** or/and magnitude **modulation of voltages generated by each converter**."); *id.*, 4792 ("A leading phase angle constitutes power transfer from the pickup to the track or primary, while a lagging phase angle enables power transfer from the track to the pickup. Thus, for any given primary and pickup voltages, both the amount and direction of power flow between the track and the pickup can be regulated by controlling the relative phase angle between voltages generated by primary and pickup reversible rectifiers.") In other words, a POSITA would have understood that *Madawala* discloses using approximately a 50% duty cycle during both charging and discharging, and that the duty cycle does not change between successive charging and discharging. (Ex. PA-DEC, ¶153.)

Madawala is in the same or similar technical field as the '067 patent and *Jang*. (Ex. PA-11, Abstract ("Demand for supplying contactless or wireless power for various applications . . . is on the rise. Inductive power transfer (IPT) is a well recognized technique through which power can be transferred from one system to another with no physical contacts. This paper presents a novel bidirectional IPT system."); Ex. PAT-A, 1:7-8 ("The present invention is directed, in general, to wireless power transmission.").) *Madawala* is also reasonably pertinent to problems associated with power converter efficiency, problems with which the inventor was involved. (Ex. PA-11, Abstract ("Results indicate that the proposed system is an ideal power interface for efficient and contactless integration."); Ex. PAT-A, 1:39 ("[S]tandard wireless power interfaces are inefficient."); *id.*, 4:37-41 ("The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by [] metallic contact battery power systems.").) A POSITA considering the problems the inventor was trying to solve would have also looked to *Madawala* because *Madawala* envisions the same type of grid tied wireless power converter discussed in the '067 patent. (Ex. PAT-A, 10:8-19 ("It is thus possible to use the power system of FIG. 2 in applications that allow the battery V401 to be successively charged and discharged without changing a duty cycle of the power trains. Examples of such applications would include using the battery V401 for load leveling of a utility grid or using the battery V401 to provide peak load demands."); Ex. PA-11, Abstract ("This paper presents a novel bidirectional IPT system, which is particularly suitable for applications such as plug-in electric vehicles (EVs) and vehicle-to-grid (V2G) systems, where two-way power transfer is advantageous.").)

In view of the above disclosure of *Madawala*, it would have been obvious, and POSITA would have been motivated, to configure *Jang*'s bi-directional power transfer system to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit. (Ex. PA-DEC, ¶155.) Given that *Jang* discloses a power train that charges and discharges a battery, and that *Madawala* discloses an applicable and beneficial technique for controlling power transfer magnitude and direction without changing a duty cycle, it would have been obvious to have the *Jang* power train be configured to enable the battery to be successively charged and discharged without changing a duty cycle of the switching circuits like *Madawala* discloses. (*Id.*) For example, a POSITA would have been motivated to modify *Jang* as described to simplify the control requirements of the *Jang* system. (Ex. PA-11, 4790 (explaining how the wireless power system is "simple in design, implementation, and control").) Further, a POSITA would have been motivated to modify *Jang* as described in order to expand its applications to accommodate high-power wireless devices. (*Id.*, ("[I]t allows for modular operation to cater for high-power applications."); Ex. PA-DEC, ¶155.) Additionally, a POSITA would look to different applications of wirelessly transferring power across devices with batteries, including for battery electric vehicles like in *Madawala*, because the principle and components required for wirelessly transferring power are the same regardless of what type of device contains a battery—such as whether it is a portable device like a mobile phone or a vehicle. (Ex. PA-DEC, ¶155.)

Further, a POSITA would have had a reasonable expectation of success with the modification. (*Id.*, ¶156.) *Madawala* discloses no more than an improved control technique to operate existing power converter switching circuits, like those disclosed by *Jang*. (*Id.*) Moreover, the proposed modification would have combined known technologies (e.g., known wireless power circuits) according to known methods (e.g., using phase changes to successively discharge and charge a battery without changing a duty cycle) to yield the predictable result of a power train that can successively charge and discharge the battery without changing a duty cycle of the switching circuits. (*Id.*, ¶156.) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

3. Claim 17

a. The system as recited in claim 16 wherein said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with a second duty cycle, said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle.

Jang in view of *Brockmann* and *Madawala* discloses or suggests the limitations of claim 17. (Ex. PA-DEC, ¶¶157-160.) As discussed above, *Jang* in view of *Brockmann* teach the elements of claim 16. (*Supra* Section VII.A.7.). And as discussed above for claim element 15[c], *Jang* discloses a system configured to enable a battery to be charged and discharged through a transformer. (*Supra* Section VII.A.6.c.)

While *Jang* does not explicitly disclose that "said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with a second duty cycle, said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle," it would have been obvious to a POSITA to modify *Jang* to implement such features in view of *Madawala*. (Ex. PA-DEC, ¶¶158.)

Madawala generally discloses the features of claim 17 for the reasons discussed above for claim 12. (*Supra* Section VII.E.2.) As discussed above, *Madawala* discloses switching circuits configured to be operated at a 50% duty cycle ("said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with said second duty cycle"), and to enable bi-directional power flow by varying the phase instead of changing the duty cycle ("enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle"). (*Id.*)

A POSITA would have found it obvious, and been motivated, to modify the system of claim 16 in view of *Madawala* for the same reasons discussed above for claim 12. (*Id.*; Ex. PA-DEC, ¶159) Likewise, a POSITA would have had a reasonable expectation of success with the modification for the same reasons. (*Supra* Section VII.E.2; Ex. PA-DEC, ¶159.)

F. SNQ6: *Jang* in view of *Soar* Renders Obvious Claims 1, 7, 9, 15 and 16

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Soar* discloses or suggests the limitations of claims 1, 7, 9, 15 and 16 of the '067 patent. (Ex. PA-DEC, ¶¶160-190.)

1. Overview of *Soar*

Soar discloses a wireless power transfer system that is applicable to various portable devices. (Ex. PA-13, 7:49-51 (describing that the disclosed "system may . . . be viewed simply as a power transfer system"); *id*., 9:3-11 (describing how a wireless power dongle can fit within a "small pocket" of a user).) Figure 4A illustrates an example embodiment of the wireless power transfer system.

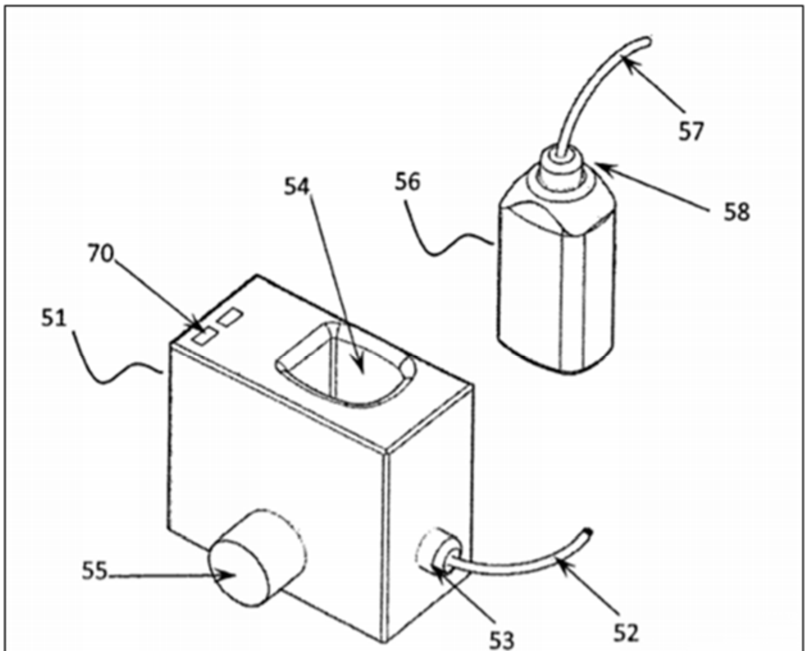


Figure 4A

(*Id.*, FIG. 4A (illustrating a wireless power dongle 56 that can receive a charge from unit 51); *id.*, 18:40-46 ("FIG. 4A shows one embodiment in which the primary inductive housing 51 receives the secondary dongle 56 in male/female mating engagement is inserted to obtain wireless inductive power transfer without the use of electrical contacts.").)

The various "inductive charging transformer circuit[s]" disclosed by *Soar* "utilize[] closely coupled ferrite cores that inherently reduce stray magnetic field to low levels." (*Id.*, 2:63-65.) For example, Figures 1A and 1B show illustrate various ferrite cores. (*Id.*, 13:36-38 ("Many core or magnetic path materials can be used, such as powdered ferrite, soft iron, laminated steel, silicon-aluminum-iron (Kool-Mu™).").)

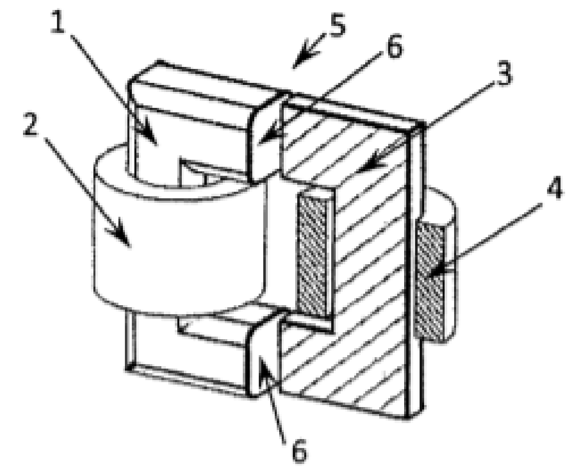


Figure 1A

(*Id.*, FIG. 1A (illustrating ferrite cores 1 and 3); *id.*, 17:27-29 ("primary ferrite core 1 . . . a secondary ferrite core 3").)

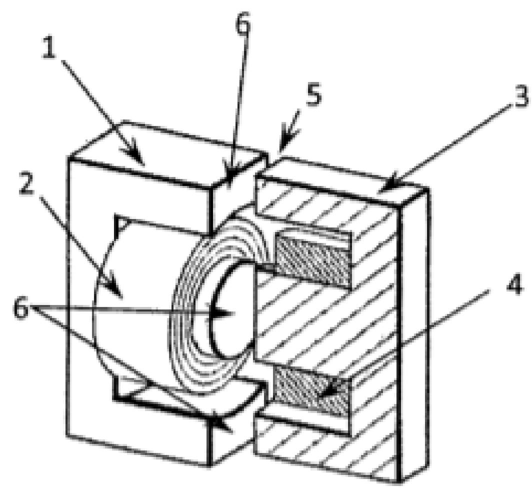


Figure 1B

(*Id.*, FIG. 1B (illustrating another embodiment of ferrite cores 1 and 3).)

The *Soar* wireless power systems include the primary ferrite core 1 with a "primary inductive coil winding 2" and the secondary ferrite core 3 with a "secondary inductive coil winding 4." (*Id.*, 17:27-29.) Figure 1B (above) illustrates an example of how coils 2 and 4 encircle the ferrite cores 1 and 3. (*Id.*, FIG. 1B (illustrating coils 2 and 4 that encircle ferrite cores 1 and 3);

id., 17:20-29 ("FIGS. 1A through 1F illustrate various ferrite core profiles that could be employed as the transformer ferrite cores in a wireless power transfer system. FIG. 1A depicts a pair of U-cores, FIG. 1B a pair of E or ETD-cores . . . . Regardless of the ferrite profile, the air core transformer is comprised of a primary ferrite core 1 with a primary inductive coil winding 2, a secondary ferrite core 3 with a secondary inductive coil winding 4.").) And together, these elements form an "air core transformer." (*Id.*, 7:44-46, 17:26-29.)

Soar is in the same or similar technical field as the '067 patent. (*Id.*, 2:45-46 ("The invention described herein [is] an inductive wireless power transfer system."); Ex. PAT-A, 1:7-8 ("The present invention is directed, in general, to wireless power transmission.").) To the extent *Soar* is not in the field of endeavor of '067 patent (it is), *Soar* is reasonably pertinent to problems associated with power converter efficiency, problems with which the inventor was involved. (Ex. PA-13, 2:63-65 ("The inductive charging transformer circuit utilises closely coupled ferrite cores that inherently reduce stray magnetic field to low levels."); *id.*,7:67-8:3 ("The substantially closed magnetic path formed between the primary and secondary coil and core assemblies provides for the efficient transmission of power."); *id.*, 17:37-42 ("Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core."); Ex. PAT-A, 1:39 ("[S]tandard wireless power interfaces are inefficient."); *id.*,4:37-41 ("The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by [] metallic contact battery power systems.").)

2. Claim 1

a. An apparatus, comprising: first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer; and a battery metallically coupled to said first metallic coil and configured to be charged and discharged through an electrically isolating path of said transformer.

Jang in view of *Soar* discloses or suggests these claim limitations. (Ex. PA-DEC, ¶¶166-175.) As discussed above for claim element 1[a], *see supra* Section VII.A.3.a, *Jang* discloses or suggests each limitation of claim 1, but to the extent *Jang* does not explicitly disclose "a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer," *Soar* does and it would have been obvious to a POSITA to modify *Jang* to include these limitations in view of the teachings of *Soar*. (Ex. PA-DEC, ¶166.)

Soar relates to "an inductive wireless charging system that utilizes two separable power ferrite core halves (FIGS. 1A-1F) that form an inductive air core transformer." (Ex. PA-13, 7:44-46; FIGS. 1A-1F.) Specifically, *Soar* discloses with reference to Figures 1A-1F, various configurations of ferrite core halves and inductive coil windings. (*Id.*, 17:20-49.)

Taking Figure 1B as an example, "FIG. 1B [depicts] a pair of E or ETD-cores." (Ex. PA-13, 17:22-26.) "Regardless of the ferrite profile" selected from Figures 1A-1F, however, the transformer is comprised of a "primary ferrite core 1" ("first magnetic core piecepart") with a "primary inductive coil winding 2," shown wound around a portion of ferrite core 1 ("a first metallic coil encircling at least a portion thereof"), and a "secondary ferrite core 3" ("second magnetic core piecepart"), "with a secondary inductive coil winding 4," shown wound around a portion of ferrite core 3 ("second metallic coil encircling at least a portion thereof"). (*Id.*, 17:26-29, FIG. 1B.)

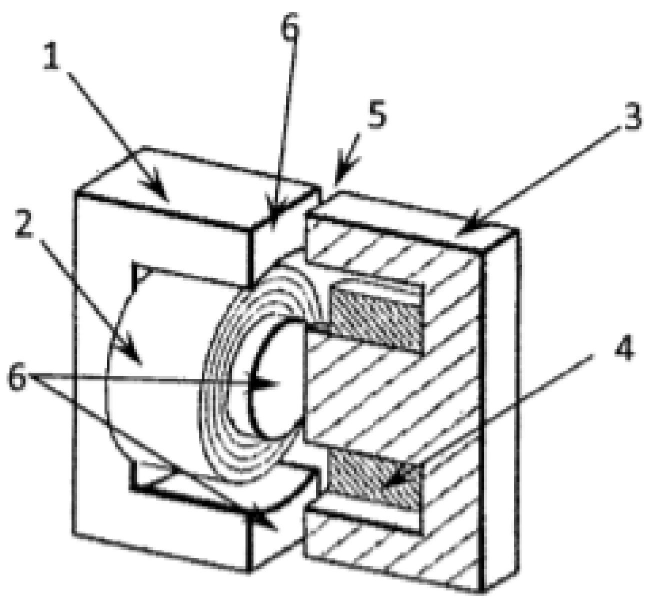


Figure 1B

(Ex. PA-13, FIG. 1B.)

The "inductive charging transformer[s]" disclosed by *Soar* "utilize[] closely coupled ferrite cores that inherently reduce stray magnetic field to low levels." (Ex. PA-13, 2:63-65, 13:36-38 ("Many core or magnetic path materials can be used, such as powdered ferrite, soft iron, laminated steel, silicon-aluminum-iron (Kool-Mu™)."); Ex. PAT-A, 5:25-29 (disclosing that a magnetic core piecepart is "typically composed of . . . a soft ferrite, powered iron, or some other ferromagnetic substance with high magnetic permeability").)

These cores, when positioned together as shown, are configured to couple flux across a transformer and cause flux paths to form through the primary and secondary windings as shown in Figure 3B. (Ex. PA-13, 18:17-39 ("FIGS. 3A and 3B present two different transformer core configurations showing the magnetic flux lines 36 for a primary 31 and secondary 33 E-Core ferrites and their respective coil windings 32,34. . . . The E-core profiles shown are schematically representative of all ferrite core types and profiles.").)

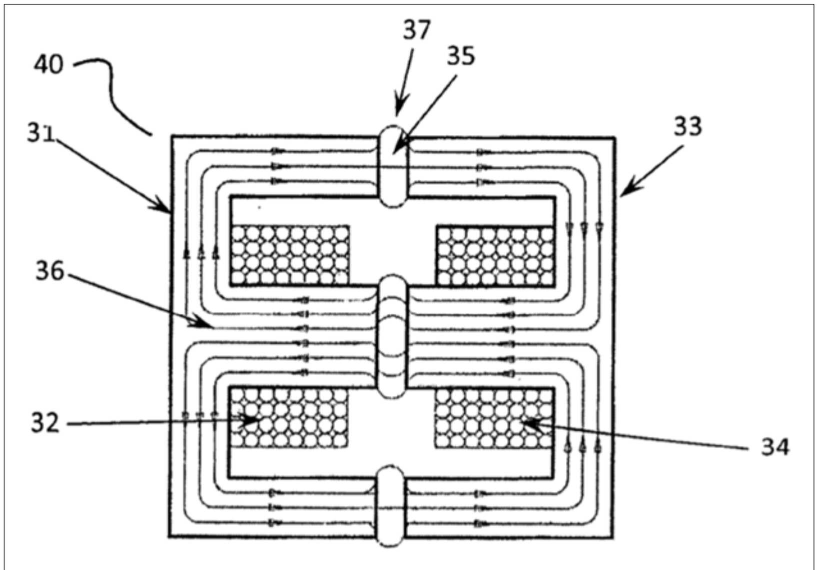


Figure 3B

(*Id.*, FIG. 3B (illustrating a cross-sectional image of the wires of metallic coils 32 and 34); *see also id.* 18:2-39 ("FIG. 3B shows a pair of E-cores forming an air-core transformer 40 with a small air gap 35 of between 1-4 mm between the three ferrite pole faces as may be used in the wireless inductive dongle power transfer system. When the magnetic flux produced by an energized primary coil bridges the air gap 35, it produces a small amount of stray magnetic flux 37, however substantially all of the magnetic flux is inductively transferred between the cores. For the same level of power transfer, minimal stray magnetic field is emitted from air gap versus large planar coils. The E-core profiles shown are schematically representative of all ferrite core types and profiles.")

A POSITA would have understood that the coils comprise metallic wires that can conduct power and data with low resistance. (*Id.*, 6:6-7 ("In a preferred embodiment the coils have a low direct current resistance."); Ex. PA-DEC, ¶171.)

Soar also discloses that the first magnetic core piecepart and corresponding coil is "configured to be coupled to, aligned with and removable from" the second magnetic core piecepart and corresponding coil. (Ex. PA-DEC, ¶¶172.) For example, "[t]he first and second coils are configured to be aligned for the inductive coupling when the dongle and the mounting component are mated so as to provide a substantially closed magnetic path between the first and second coils for at least transfer of power between the first and second coils." (Ex. PA-13, 5:40-45; *see also* Abstract ("coils are positioned . . . so that they are aligned for their inductive coupling when the dongle and mounting component are mated," and the "positioning and alignment of the coils provides a substantially closed magnetic path between the coils").) Figure 1B and 3B (above) illustrate how the ferrite cores are aligned and coupled together to form a transformer. (*Id.*, FIGs. 1B, 3B.) Further, the cores and coils are removable from each other to facilitate the portable wireless system. (*Id.*, 15:42-45 ("The primary power receptacle can be placed at any angle that facilitates the insertion and removal of the dongle without causing any untoward strain on either the dongle cable or the soldier."); *id.*, 18:40-45 ("FIG. 4A shows one embodiment in which the primary inductive housing 51 receives the secondary dongle 56 in male/female mating engagement is inserted to obtain wireless inductive power transfer without the use of electrical contacts.").)

In view of the above disclosure of *Soar*, it would have been obvious and a POSITA would have been motivated to use a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer in *Jang*. As *Soar* explains, such an arrangement provides the benefit of enhanced coil coupling and low stray or residual magnetic flux. (*Id.*, 12:13-18; Ex. PA-DEC, ¶173.) Indeed, utilizing the symmetrical combination of ferrite cores and coils described by *Soar* would have increased the power efficiency of the *Jang* bidirectional power system. (Ex. PA-13, 17:33-42 ("When the primary coil is energized with an alternating current, a magnetic field is produced such that magnetic flux is emitted from the ferrite core pole faces 6 allowing magnetic or inductive coupling to a secondary ferrite core and winding. Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core."); Ex. PA-DEC, ¶¶173.) Additionally, the proposed configuration would have reduced the electromagnetic interference noise generated in the wireless power system. (Ex. PA-13, 12:64-67 ("A benefit of a pot core ferrite structures is that the outer shell more completely encases the primary and secondary winding and for the most part reduces eliminates any radiated energy such as EMI or stray magnetic flux."); Ex. PA-DEC, ¶173.)

A POSITA would have looked to *Soar* because it is in the same or similar technical field as *Jang*, as both relate to principles and components requires for wirelessly transferring power, which are the same regardless of what type of device power is being transferred to. (Ex. PA-13, 2:45-46 ("The invention described herein [is] an inductive wireless power transfer system.").)

Soar is also pertinent to problems associated with power transfer efficiency, which would be applicable to *Soar*'s power converter. (*Id.*, 2:63-65 ("The inductive charging transformer circuit utilises closely coupled ferrite cores that inherently reduce stray magnetic field to low levels."); *id.*,7:67-8:3 ("The substantially closed magnetic path formed between the primary and secondary coil and core assemblies provides for the efficient transmission of power."); *id.*, 17:37-42 ("Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core.")

A POSITA having looked to *Soar* would have had a reasonable expectation of success in modifying *Jang* in view of *Soar*, as the proposed modification would have combined known technologies (e.g., known wireless power magnetic core and coil configurations) according to known methods (e.g., using wireless power cores with surrounding coils to transmit power) to yield the predictable result of a wireless power apparatus wherein the coils partially encircle magnetic core pieceparts. (*Id.*, FIGs. 1-2B, 5:62-66; Ex. PA-DEC, ¶¶174.) See *KSR Intern. Co. v. Teleflex Inc*., 550 U.S. 398, 416 (2007).

The analysis for the remaining limitations of claim 1 is the same as presented for claim 1 in SNQ1. (*See supra* Section VII.A.3.) Further, *Jang* in view of *Soar* discloses or suggests the "magnetic core piecepart" under the District Court's construction, *see supra* Section V, where the "magnetic core piecepart" is a "core piece that is made of magnetic material," because as described above, a POSITA would have found it obvious to increase the power efficiency of the *Jang* bidirectional power system by implementing an arrangement similar to that described in *Soar*, which utilizes two separable power ferrite core halves (i.e., core pieces made of magnetic material). (Ex. PA-DEC, ¶175.) Likewise, *Jang* in view of *Soar* discloses or suggests the "magnetic core piecepart" under the Board's construction, *see supra* Section V, where the "magnetic core piecepart" is "a magnetic part that cooperates with at least one other magnetic part to create a flux path that passes through the first and second metallic coils." (*Id.*) As described above, a POSITA would have been motivated to improve the *Jang* bidirectional power system by implementing an arrangement similar to that described in *Soar*, which utilizes two separable power ferrite core halves (two magnetic parts), each with inductive coil windings, which when positioned together cause flux paths to form through the coil windings. (*Id.*)

3. Claim 7

a. The apparatus as recited in claim 1 further comprising a power train including a first switching circuit coupled to said first metallic coil configured to form a portion of a resonant topology with a second switching circuit coupled to said second metallic coil.

Jang and *Soar* disclose or suggest the limitations of claim 7 for the same reasons presented above for claims 1 and 7. (*See supra* Sections VII.A.3, 4; Ex. PA-DEC, ¶176.) That *Jang* is combined with *Soar* instead of *Brockmann* does not change the applicability of the analysis to the *Jang* apparatus discussed here in SNQ 6. (Ex. PA-DEC, ¶176.)

4. Claim 9

a. The apparatus as recited in claim 7 wherein said power train is configured to be intermittently operated in a burst mode of operation to control a characteristic of said battery.

Jang and *Soar* disclose or suggest the limitations of claim 9 for the same reasons presented above for claims 7 and 9. (*See supra* Sections VII.A.4, 5; Ex. PA-DEC, ¶177.) That *Jang* is combined with *Soar* instead of *Brockmann* does not change the applicability of the analysis to the *Jang* apparatus discussed in SNQ 6. (Ex. PA-DEC, ¶177.)

5. Claim 15

a. A system, comprising:

Jang discloses this limitation for the same reasons presented above for claim 15 in SNQ 1. (*See supra* Section VII.A.6; Ex. PA-DEC, ¶178.)

b. a wireless battery interface including a wireless battery interface magnetic core piecepart; and a wireless battery, including: a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer; and a battery metallically coupled to a first metallic coil encircling at least a portion of said wireless battery magnetic core piecepart and configured to be charged and discharged through an electrically isolating path of said transformer.

Jang in view of *Soar* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶179-188.) As discussed above for claim 15, *see supra* Section VII.A.6, *Jang* discloses or suggests each limitation of claim 15, but to the extent *Jang* does not explicitly disclose "a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer," *Soar* does and it would have been obvious to a POSITA to modify *Jang* to include these limitations in view of the teachings of *Soar*. (Ex. PA-DEC, ¶179.)

Soar relates to "an inductive wireless charging system that utilizes two separable power ferrite core halves (FIGS. 1A-1F) that form an inductive air core transformer." (Ex. PA-13, 7:44-46.) Specifically, *Soar* discloses with reference to Figures 1A-1F, various configurations of ferrite core halves and inductive coil windings. (*Id.*, 17:20-49.)

Taking Figure 1B as an example, "FIG. 1B [depicts] a pair of E or ETD-cores." (*Id.*, 17:22-26.) "Regardless of the ferrite profile" selected from Figures 1A-1F, however, the transformer is comprised of a "primary ferrite core 1" ("wireless battery magnetic core piecepart") with a "primary inductive coil winding 2", shown wound around a portion of ferrite core 1 ("a first metallic coil encircling at least a portion of said wireless battery magnetic core piecepart"), and a "secondary ferrite core 3" ("wireless battery interface magnetic core piecepart"), "with a secondary inductive coil winding 4," shown wound around a portion of ferrite core 3. (*Id.*, 17:26-29, FIG. 1B.)

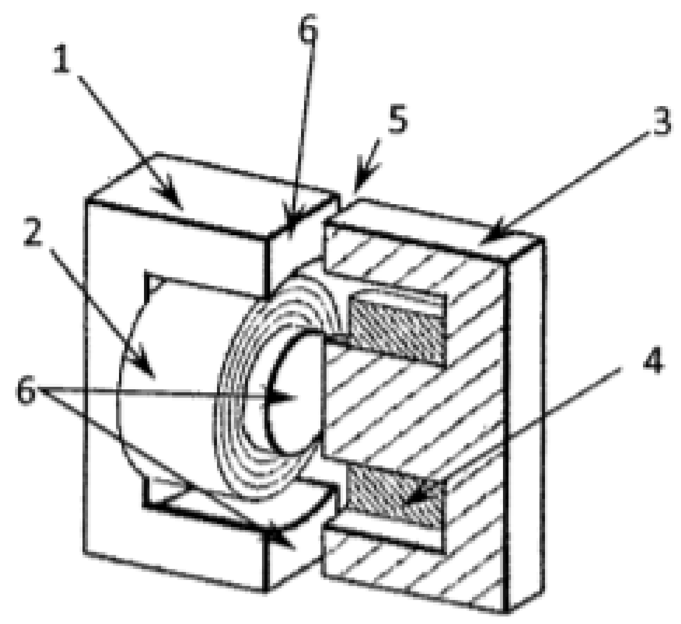


Figure 1B

(*Id.*, FIG. 1B.)

The "inductive charging transformer[s]" disclosed by *Soar* "utilize[] closely coupled ferrite cores that inherently reduce stray magnetic field to low levels." (*Id.*, 2:63-65, 13:36-38 ("Many core or magnetic path materials can be used, such as powdered ferrite, soft iron, laminated steel, silicon-aluminum-iron (Kool-Mu™)."); Ex. PAT-A, 5:25-29 (disclosing that a magnetic core piecepart is "typically composed of . . . a soft ferrite, powered iron, or some other ferromagnetic substance with high magnetic permeability").)

These cores, when positioned together as shown, are configured to couple flux across a transformer and cause flux paths to form through the primary and secondary windings as shown in Figure 3B. (Ex. PA-13, 18:17-39 ("FIGS. 3A and 3B present two different transformer core configurations showing the magnetic flux lines 36 for a primary 31 and secondary 33 E-Core ferrites and their respective coil windings 32,34. . . . The E-core profiles shown are schematically representative of all ferrite core types and profiles.").)

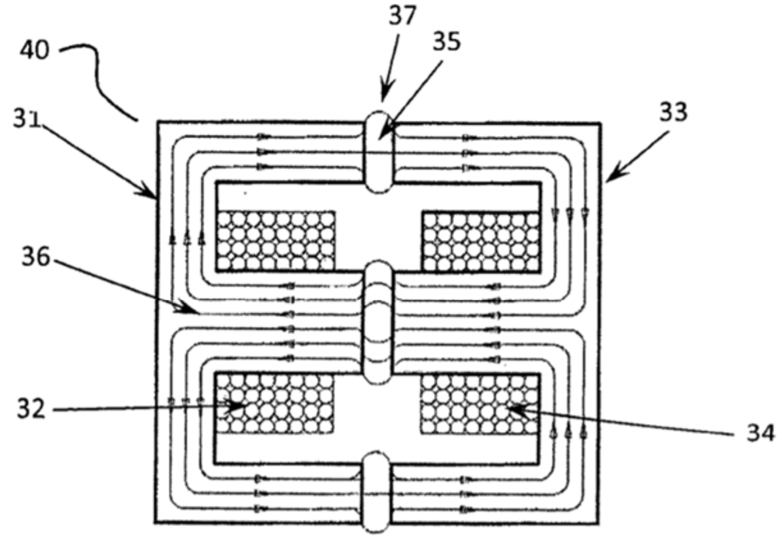


Figure 3B

(*Id.*, FIG. 3B (illustrating a cross-sectional image of the wires of metallic coils 32 and 34); *see also id.* 18:2-39 ("FIG. 3B shows a pair of E-cores forming an air-core transformer 40 with a small air gap 35 of between 1-4 mm between the three ferrite pole faces as may be used in the wireless inductive dongle power transfer system. When the magnetic flux produced by an energized primary coil bridges the air gap 35, it produces a small amount of stray magnetic flux 37, however substantially all of the magnetic flux is inductively transferred between the cores. For the same level of power transfer, minimal stray magnetic field is emitted from air gap versus large planar coils. The E-core profiles shown are schematically representative of all ferrite core types and profiles.")

A POSITA would have understood that the coils comprise metallic wires that can conduct power and data with low resistance. (*Id.*, 6:6-7 ("In a preferred embodiment the coils have a low direct current resistance."); Ex. PA-DEC, ¶184.)

Soar also discloses that the wireless battery magnetic core piecepart and corresponding coil is "configured to be coupled to, aligned with and removable from" the wireless battery interface magnetic core piecepart. (Ex. PA-DEC, ¶185.) For example, "[t]he first and second coils are configured to be aligned for the inductive coupling when the dongle and the mounting component are mated so as to provide a substantially closed magnetic path between the first and second coils for at least transfer of power between the first and second coils." (Ex. PA-13, 5:40-45; *see also* Abstract ("coils are positioned . . . so that they are aligned for their inductive coupling when the dongle and mounting component are mated," and the "positioning and alignment of the coils provides a substantially closed magnetic path between the coils").) Figure 1B and 3B (above) illustrate how the ferrite cores are aligned and coupled together to form a transformer. (*Id.*, FIGs. 1B, 3B.) Further, the cores and coils are removable from each other to facilitate the portable wireless system. (*Id.*, 15:42-45 ("The primary power receptacle can be placed at any angle that facilitates the insertion and removal of the dongle without causing any untoward strain on either the dongle cable or the soldier."); *id.*, 18:40-45 ("FIG. 4A shows one embodiment in which the primary inductive housing 51 receives the secondary dongle 56 in male/female mating engagement is inserted to obtain wireless inductive power transfer without the use of electrical contacts.").)

In view of the above disclosure of *Soar*, it would have been obvious and a POSITA would have been motivated to use a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer in *Jang*. As *Soar* explains, such an arrangement provides the benefit of enhanced coil coupling and low stray or residual magnetic flux. (*Id.*, 12:13-18; Ex. PA-DEC, ¶186.) Indeed, utilizing the symmetrical combination of ferrite cores and coils described by *Soar* would have increased the power efficiency of the *Jang* bidirectional power system. (Ex. PA-13, 17:33-42 ("When the primary coil is energized with an alternating current, a magnetic field is produced such that magnetic flux is emitted from the ferrite core pole faces 6 allowing magnetic or inductive coupling to a secondary ferrite core and winding. Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core."); Ex. PA-DEC, ¶¶186.) Additionally, the proposed configuration would have reduced the electromagnetic interference noise generated in the wireless power system. (Ex. PA-13, 12:64-67 ("A benefit of a pot core ferrite structures is that the outer shell more completely encases the primary and secondary winding and for the most part reduces eliminates any radiated energy such as EMI or stray magnetic flux.").)

A POSITA would have looked to *Soar* because it is in the same or similar technical field as *Jang*, as both relate to principles and components requires for wirelessly transferring power, which are the same regardless of what type of device power is being transferred to. (*Id.*, 2:45-46 ("The invention described herein [is] an inductive wireless power transfer system."); Ex. PA-DEC, ¶187.) *Soar* is also pertinent to problems associated with power transfer efficiency, which would be applicable to *Soar*'s power converter. (Ex. PA-13, 2:63-65 ("The inductive charging transformer circuit utilises closely coupled ferrite cores that inherently reduce stray magnetic field to low levels."); *id.*, 7:67-8:3 ("The substantially closed magnetic path formed between the primary and secondary coil and core assemblies provides for the efficient transmission of power."); *id.*, 17:37-42 ("Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core.").)

A POSITA having looked to *Soar* would have had a reasonable expectation of success in modifying *Jang* in view of *Soar*, as the proposed modification would have combined known technologies (e.g., known wireless power magnetic core and coil configurations) according to known methods (e.g., using wireless power cores with surrounding coils to transmit power) to yield the predictable result of a wireless power apparatus wherein the coils partially encircle magnetic core pieceparts. (*Id.*, FIGs. 1-2B, 5:62-66.) See *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

The analysis for the remaining limitations of claim 15 is the same as presented for claim 15 in SNQ 1. (*See supra* Section VII.A.6; Ex. PA-DEC, ¶188.) Further, *Jang* in view of *Soar* discloses or suggests the "magnetic core piecepart" under both the District Court and Board's constructions for similar reasons as explained for claim 1 in *supra* Section VII.F.2. (Ex. PA-DEC, ¶188.)

6. Claim 16

a. The system as recited in claim 15 further comprising a power train including a first switching circuit of said wireless battery configured to form a portion of a resonant topology with a second switching circuit of said wireless battery interface.

Jang and *Soar* disclose or suggest the limitations of claim 16 for the same reasons presented above for claims 15 and 16. (*See supra* Sections VII.A.6, 7; Ex. PA-DEC, ¶189.) That *Jang* is combined with *Soar* instead of *Brockmann* does not change the applicability of the analysis to the *Jang* apparatus discussed in SNQ 6. (Ex. PA-DEC, ¶189.)

G. SNQ7: *Jang* in view of *Soar* and *Yang* Renders Obvious Claim 8

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Soar* and further in view of *Yang* discloses or suggests the limitations of claim 8 of the '067 patent. (Ex. PA-DEC, ¶¶190-191.)

1. Claim 8

a. The apparatus as recited in claim 7 further comprising a controller configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level.

Jang in view of *Soar* and *Yang* discloses or suggests the limitations of claim 8 for the reasons discussed (*supra* Section VII.B) in SNQ 2 (*Jang* in view of *Brockmann* and *Yang*). (Ex. PA-DEC, ¶191.) The analysis for modifying *Jang* in light of *Yang* in SNQ 2 is applicable to the modified *Jang-Soar* combination. (Ex. PA-DEC, ¶191.) Thus, given the bridge circuit of the *Jang-Soar* power train, a POSITA would have been motivated to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level, as suggested by *Yang*, for the reasons discussed. (Ex. PA-DEC, ¶191.)

H. SNQ8: *Jang* in view of *Soar* and *Kardolus* Renders Obvious Claim 9

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Soar* and further in view of *Kardolus* discloses or suggests the limitations of claim 9 of the '067 patent. (Ex. PA-DEC, ¶¶192-193.)

1. Claim 9

a. The apparatus as recited in claim 7 wherein said power train is configured to be intermittently operated in a burst mode of operation to control a characteristic of said battery.

Jang in view of *Soar* and *Kardolus* discloses or suggests the limitations of claim 9 for the reasons discussed (*supra* Section VII.C) in SNQ 3. (Ex. PA-DEC, ¶193.) The analysis of *Kardolus* in SNQ 3 is applicable here to the modified *Jang-Soar* combination. (Ex. PA-DEC, ¶193.) Thus, given the burst mode teachings of *Jang*, a POSITA would have been motivated to select a capacitor to produce zero-current switching of a first switching circuit in conjunction with an inductor, as suggested by *Lee*, for the reasons discussed. (Ex. PA-DEC, ¶193.)

I. SNQ9: *Jang* in view of *Soar* and *Lee* Renders Obvious Claims 10 and 11

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Soar* and further in view of *Lee* discloses or suggests the limitations of claims 10 and 11 of the ’067 patent. (Ex. PA-DEC, ¶¶194-196.)

1. Claim 10

a. The apparatus as recited in claim 7 further comprising a capacitor selected to produce substantially zero-current switching of said first switching circuit in said power train in conjunction with an inductor.

Jang in view of *Soar* and *Lee* discloses or suggests the limitations of claim 10 for the reasons discussed (*supra* Section VII.D) in SNQ 4. (Ex. PA-DEC, ¶195.) The analysis of *Lee* in SNQ 4 is applicable here to the modified *Jang-Soar* combination. (Ex. PA-DEC, ¶195.) Thus, given the capacitive and inductive elements of the *Jang-Soar* power system, a POSITA would have been motivated to select a capacitor to produce zero-current switching of a first switching circuit in conjunction with an inductor, as suggested by *Lee*, for the reasons discussed. (Ex. PA-DEC, ¶195.)

2. Claim 11

a. The apparatus as recited in claim 10 wherein said inductor is formed at least in part with said first metallic coil.

Jang in view of *Soar* and *Lee* discloses or suggests the limitations of claim 11 for the reasons discussed (*supra* Section VII.D) in SNQ 4. (Ex. PA-DEC, ¶196.) That *Jang* is combined with *Soar* instead of *Brockmann* does not change the applicability of the analysis to the *Jang* apparatus/system discussed in SNQ 4. (Ex. PA-DEC, ¶196.)

J. SNQ10: *Jang* in view of *Soar* and *Madawala* Renders Obvious Claims 12 and 17

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jang* in view of *Soar* and further in view of *Madawala* discloses or suggests the limitations of claims 12 and 17 of the ’067 patent. (Ex. PA-DEC, ¶¶197-199.)

1. Claim 12

a. The apparatus as recited in claim 7 wherein said power train is configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit.

Jang in view of *Soar* and *Madawala* discloses or suggests the limitations of claim 12 for the reasons discussed (*supra* Section VII.E) in SNQ 5. (Ex. PA-DEC, ¶198.) The analysis of *Madawala* in SNQ 5 is applicable to the modified *Jang*-*Soar* combination. (Ex. PA-DEC, ¶198.) Thus, given duty cycle operations of the *Jang*-*Soar* power train to charge and discharge a battery, a POSITA would have been motivated to have the power train configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit, as suggested by *Madawala*, for the reasons discussed. (Ex. PA-DEC, ¶198.)

2. Claim 17

a. The system as recited in claim 16 wherein said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with a second duty cycle, said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle.

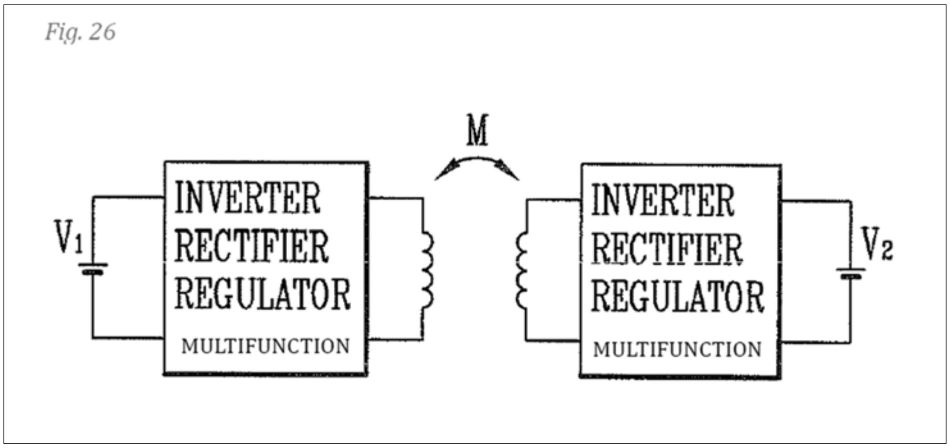
Jang in view of *Soar* and *Madawala* discloses or suggests the limitations of claim 17 for the reasons discussed (*supra* Section VII.E) in SNQ 5. (Ex. PA-DEC, ¶199.) The analysis of *Madawala* in SNQ 5 is applicable to the modified *Jang*-*Soar* combination. (Ex. PA-DEC, ¶199.) Thus, given duty cycle operations of the *Jang*-*Soar* power train to charge and discharge a battery, a POSITA would have been motivated to have the power train configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit, as suggested by *Madawala*, for the reasons discussed. (*Id.*, ¶199.)

K. SNQ11: *Jeong* in view of *Chao* Renders Obvious Claims 1, 7, 15, and 16

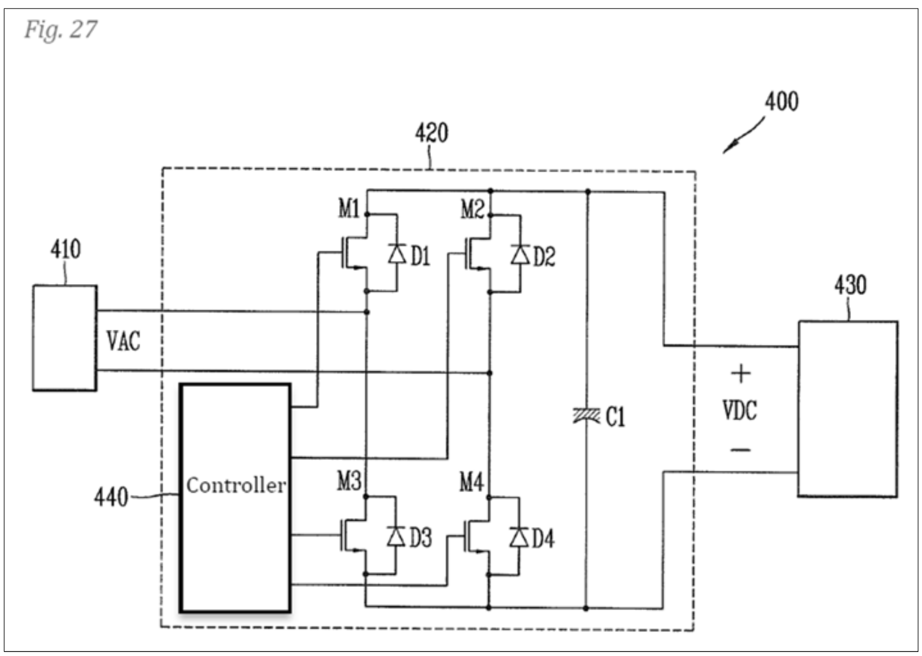
As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Chao* discloses or suggests the limitations of claims 1, 7, 9, 15, and 16 of the ’067 patent. (Ex. PA-DEC, ¶¶200-232.)

1. Overview of *Jeong*

Jeong discloses a bidirectional wireless power system. (Ex. PA-9, FIG. 26; *id.*, ¶[0028] (emphasis added) ("Fig. 26 is a conceptual diagram of the wireless power transmission system in which **bidirectional transmission of wireless power** is possible.").)



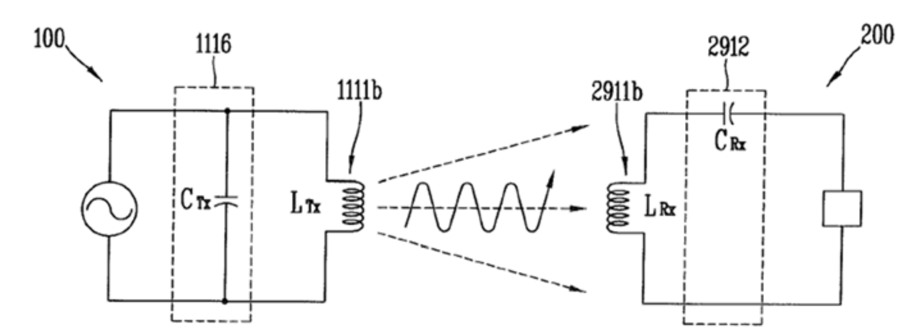
(Ex. PA-9, FIG. 26.) Figure 27 provides a component level diagram of an inverter-rectifier-regulator/power transceiver used in FIG. 26, showing its full-bride switching circuit comprised of switches M1-M4. (*Id.*, ¶[0356].)



(*Id.*, FIG. 27.) The power transceiver disclosed in Figure 27 may enable a cell phone to wirelessly power a remote load or receive a charge. (*Id.*, ¶[0357] ("The wireless power transceiver (400) capable of bidirectional wireless power transmission can transmit wireless power in discharge mode, and receive wireless power in charge mode."); *id.*, ¶[0042] (explaining the wireless power systems of the specification are applicable to "mobile phones, cellular phones, smart phones," etc.).) "[W]hen a pair of wireless power transceivers (400) having the same structure form a wireless power transmission system, one of the wireless power transceivers (400) can operate in discharge mode, and the other wireless power transceiver (400) operate in charge mode." (*Id.*, ¶[0357].) In the pair configuration, the first power transceiver includes "coil unit (410)" and the second power transceiver includes another "coil unit (410)." (*Id.*, ¶[0357]; *id.*, FIG. 27.)

Jeong also discloses that the coils are configured to be coupled to, aligned with and removable from each other in the wireless system. For example, the coils are electro-magnetically coupled to transmit power. (*Id.*, FIG. 6; *id.*, ¶[0143] (emphasis added) (illustrating the "concept in which power is wirelessly transmitted from a wireless power transmitter to an electronic device according to embodiments supporting a **resonance coupling method**.").)

Fig. 6



(*Id.*, FIG. 6.) Further, power transmission occurs most efficiently when the coils are aligned. (*Id.*, ¶[0106] ("The efficiency of wireless power transfer by the inductive coupling method . . . is affected by the alignment and the distance between the wireless power transmitter (100) including each coil and the electronic device (200)."); *see also id.*, ¶[0357] (explaining that the power coils form a pair to transmit power).) The wireless power devices that contain the coils are removable from each other and the system identifies when the devices are within "range" of each other. (*Id.*, ¶[0276].)

More generally, *Jeong* is in the same or similar technical field as the '067 patent. (*Id.*, ¶[0001] ("The embodiments of the present invention relate to wireless power transmission."); *id.*, ¶[0357] ("[T]he wireless power transceiver (400) capable of bidirectional wireless power transmission.”); Ex. PAT-A, 1:7-8 (“The present invention is directed, in general, to wireless power transmission.”).) To the extent *Jeong* is not in the field of endeavor of ’067 patent (it is), *Jeong* is reasonably pertinent to problems associated with power converter efficiency, problems with which the inventor was involved. (Ex. PA-9, ¶[0026]-[0027] (“The wireless power receiver structured as above and related to at least one embodiment of the invention is formed so that the rectifier also functions as a DC/DC converter, which can lower the voltage/current grades of the components in the receiving side and increase the efficiency of the receiver. Moreover, by sensing the impedance change of the wireless power transmitter through the operation of the wireless power receiver, the wireless power transmission system can be controlled more efficiently. In this way, a wireless transmission system, which operates more efficiently, can be built.”); Ex. PAT-A, 1:39 (“[S]tandard wireless power interfaces are inefficient.”); *id.*, 4:37-41 (“The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by [] metallic contact battery power systems.”).)

2. Overview of *Chao*

Chao discloses a wireless power system for a battery. (Ex. PA-12, 1:5-10 (“The present invention relates to a charging device for use with mobile phones, more particularly, to a contact-free type charging device for use with mobile phones, which delivers electrical energy to the mobile phone through magnetic induction.”), FIG. 1, battery 11.) Figure 1, for example, illustrates induced-type power supply 10 that may be arranged within the handset of a mobile phone. (Ex. PA-12, 2:42-44.)

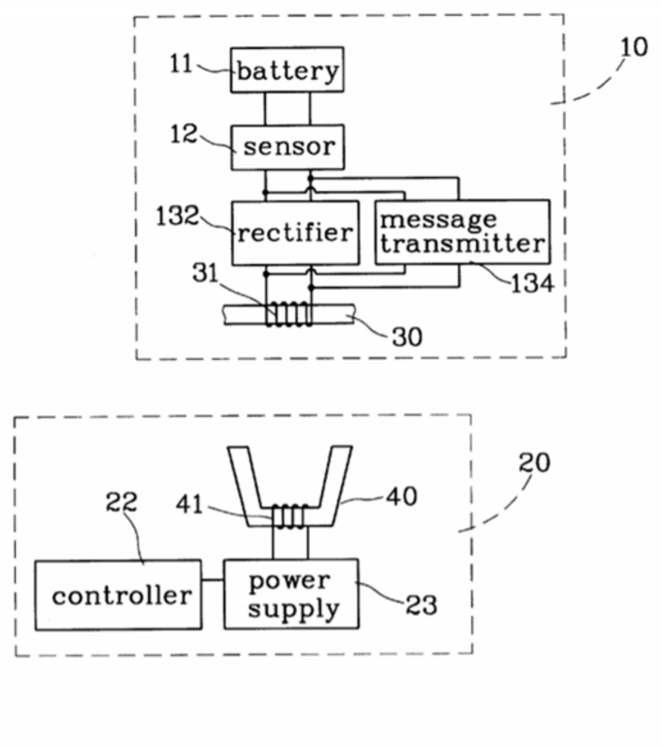


FIG. 1

(*Id.*, FIG. 1.)

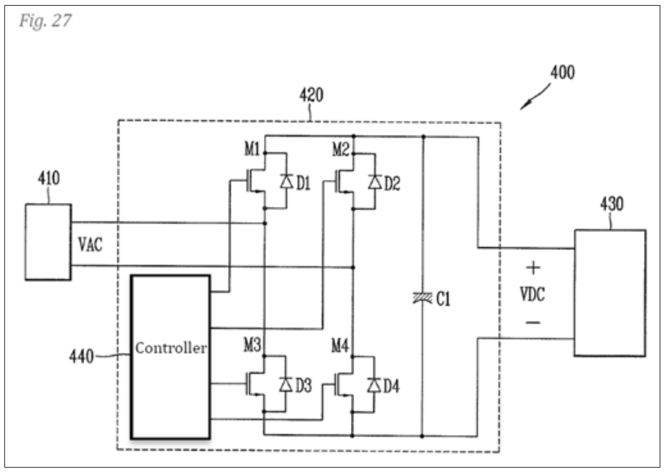
With respect to Figure 1, charging stage 20 induces a current in induced-type power supply 10 to charge battery 11 wirelessly. (*Id.*, 3:40-49.) The wireless power system includes "primary iron core 40" and "iron core 30." (*Id.*, FIG 1, 3:40-42, 2:49-52.) Primary coil 41 spirally wraps around primary iron core 40. (*Id.*, FIG. 1, 3:43-45.) Similarly, coil 31 spirally wraps around iron core 30. (*Id.*, FIG. 1, 3:47-49.)

More generally, *Chao* is in the same or similar technical field as the '067 patent. (*Id.*, Abstract ("The inventive charging device use magnetic induction, rather than metal contact, to transfer electrical energy to battery."); *id.*, Ex.FIG. 1; Ex. PAT-A, 1:7-8 ("The present invention is directed, in general, to wireless power transmission.").) To the extent *Chao* is not in the field of endeavor of '067 patent (it is), *Chao* is reasonably pertinent to problems associated with power converter efficiency, problems with which the inventor was involved. (*Id.*, 4:6-11 ("Moreover, the shape and arrangement of the primary iron core 40 are such that the magnetic flux thereof has efficient coupling to the secondary iron core, thus increasing the alignment tolerance of the charging device."); Ex. PAT-A, 1:39 ("[S]tandard wireless power interfaces are inefficient."); *id.*, 4:37-41 ("The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by [] metallic contact battery power systems.").)

3. Claim 1

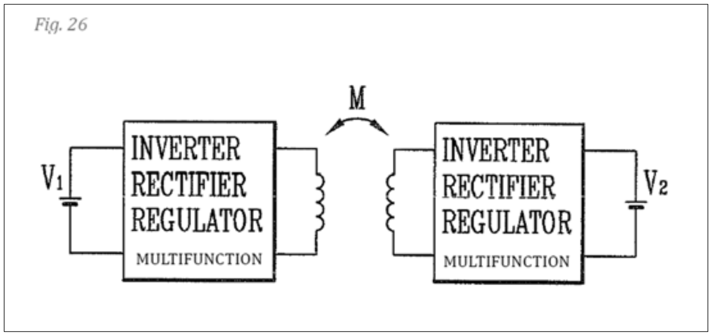
a. [1.a] An apparatus, comprising:

To the extent the preamble is limiting, *Jeong* discloses this limitation. (Ex. PA-DEC, ¶¶206-207.) For example, *Jeong* discloses a wireless power transceiver ("apparatus") in Figure 27. (Ex. PA-9, ¶[0356], FIG. 27.)



(*Id.*, FIG. 27.)

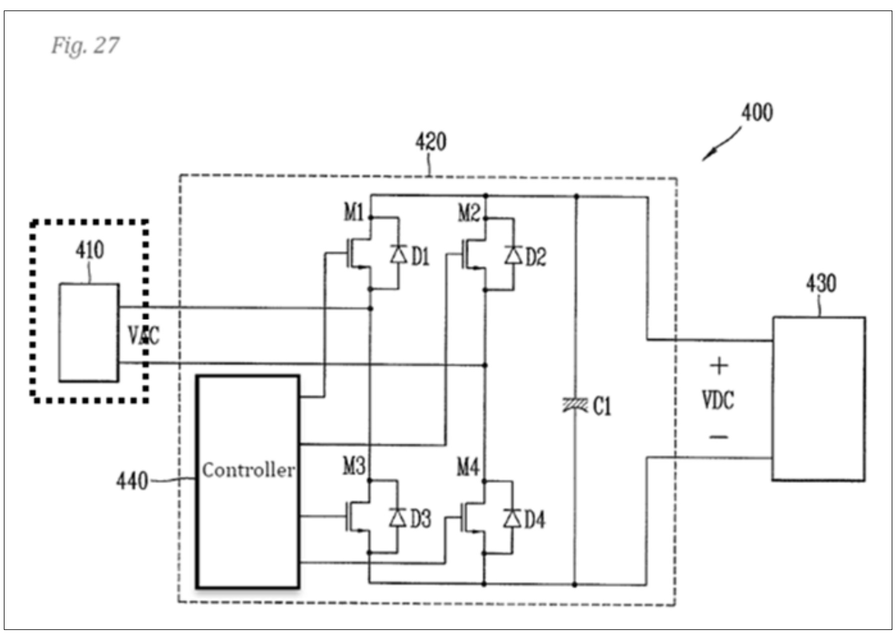
"The wireless power transceiver (400) capable of bidirectional wireless power transmission can transmit wireless power in discharge mode, and receive wireless power in charge mode." (Ex. PA-9, ¶[0357].) "[W]hen a pair of wireless power transceivers (400) having the same structure form a wireless power transmission system, one of the wireless power transceivers (400) can operate in discharge mode, and the other wireless power transceiver (400) operate in charge mode." (*Id.*.) In other words, *Jeong* discloses that two of the Figure 27 apparatuses can be coupled to form a bidirectional wireless power system as shown in Figure 26. (Ex. PA-9, FIG. 26; *id.*, ¶[0356]-[0357]; *id.*, ¶[0028] ("Fig. 26 is a conceptual diagram of the wireless power transmission system in which **bidirectional transmission of wireless power** is possible.") (emphasis added); ¶[0006] (An objective of the invention is "to provide a wireless power system, which is capable of bi-directionally transmitting wireless power via a wireless transmission system configured with a pair of wireless power transceivers in identical structures").)



(*Id.*, FIG. 26.)

b. [1.b] a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer; and

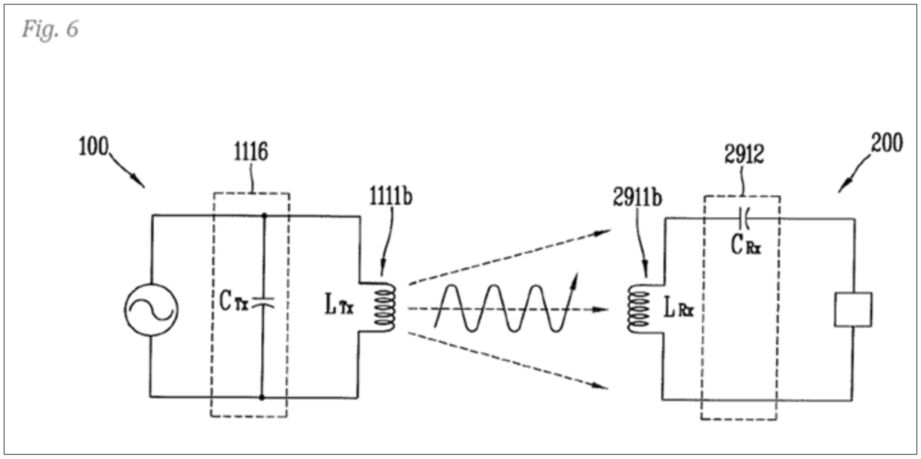
Jeong in view of *Chao* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶208-218.) For instance, *Jeong* discloses that its bidirectional wireless power system transfers power between a "pair" of power transceivers 400. (Ex. PA-9, ¶[0357], FIG. 26 (illustrating that the system includes a pair of inverter-rectifier-regulators).) And each power transceiver includes a "coil unit (410)." (*Id.*, ¶[0357], FIG. 27.) Thus the first power transceiver includes "coil unit (410)" (first metallic coil) and the second power transceiver includes a "coil unit (410)" (second metallic coil). (*Id.*, ¶[0357]; *id.*, FIG. 27.)



(*Id.*, FIG. 27 (annotated) (illustrating a power transceiver 400 includes a coil unit 410); Ex. PA-DEC, ¶208.)

A POSITA would have understood that coil units 410 are metallic coils, as they are suitable for "forming a . . . circuit" and the transmission of wireless power. (Ex. PA-9, ¶¶[0357]-[0358]; Ex. PA-DEC, ¶208.) To the extent *Jeong* is read not to disclose metallic coils, using metallic coils (as opposed to another type of coil) would have been nothing more than an obvious substitution—a nonmetallic wireless power coil for a conventional, metallic wireless power coil—to obtain a predictable metallic coil implementation. *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007) ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."). Indeed, a POSITA would have been motivated to use conventional metallic wires, such as Litz wire, to implement the coils for the benefits associated therewith. (*See, e.g.*, Ex. PA-1, 7:14-21 (explaining that the coils of a wireless power system were built using metallic "magnet wire"); Ex. PA-10, 5:48-53 ("In the illustrated embodiment, the secondary coil 62 is a generally conventional center-tapped coil of wire, such as Litz wire. The characteristics of the secondary coil 62 (e.g. wire size, wire type, number of turns, shape of coil) will vary from application to application to achieve the desired functionality."); Ex. PA-DEC, ¶208.)

Jeong also discloses that the coils are configured to be coupled to, aligned with and removable from each other in the wireless system to form a transformer. (Ex. PA-DEC, ¶209.) For example, the coils are electro-magnetically coupled to transmit power ("coupled . . to form a transformer"). (*Id.*, FIG. 6; *id.*, ¶[0143] (illustrating the "concept in which power is wirelessly transmitted from a wireless power transmitter to an electronic device according to embodiments supporting a **resonance coupling method**") (emphasis added).)



(*Id.*, FIG. 6.) Further, *Jeong* notes that power transmission occurs most efficiently when the coil units are aligned, which indicates that the coils are configured to be aligned with each other. (*Id.*, ¶[0106] ("The efficiency of wireless power transfer by the inductive coupling method . . . is affected by the alignment and the distance between the wireless power transmitter (100) including each coil and the electronic device (200)."); *see also id.*, ¶[0357] (explaining that coil units 410 form a pair to transmit power).) The wireless power devices that contain the coils are removable from each other and the system identifies when the devices are within "range" of each other. (*Id.*, ¶[0276].)

Although *Jeong* discloses a first metallic coil and a second metallic coil, it does not explicitly disclose the coils encircling at least a portion a first or second magnetic core piecepart (and accordingly that the cores are configured to be coupled to, aligned with and removable from each other in the wireless system to form the transformer). However, it would have been obvious to a POSITA to modify *Jeong* to include this limitation in view of the teachings of *Chao*. (Ex. PA-DEC, ¶210.)

Chao is generally directed to "a charging device for [a] mobile phone wherein the battery can be charged by a secondary coil with current induced from a primary coil," using "magnetic induction, rather than metal contact, to transfer electrical energy to [a] battery." (Ex. PA-12, Abstract.) Thus, like *Jeong*, *Chao* relates to transferring power wirelessly between devices—including mobile phones (Ex. PA-9, ¶[0042] ("the electronic device for receiving power wirelessly . . . should be interpreted as encompassing . . . mobile phones [and] cellular phones"); Ex. PA-12, Abstract ("a charging device for mobile phone"))—and a POSITA would have been interested in considering the teachings of *Chao* when implementing *Jeong*. (Ex. PA-DEC, ¶211.)

Chao discloses, for example, primary iron core 40 ("first magnetic core piecepart") with primary coil 41 spirally wrapped around it ("first metallic coil encircling at least a portion thereof"). (Ex. PA-12, FIG. 1, 3:40-47.) Similarly, *Chao* discloses secondary iron core 30 ("second magnetic core piecepart") with coil 31 spirally wrapped around it ("second metallic coil encircling at least a portion thereof"). (*Id.*, FIG. 1, 3:47-49.)

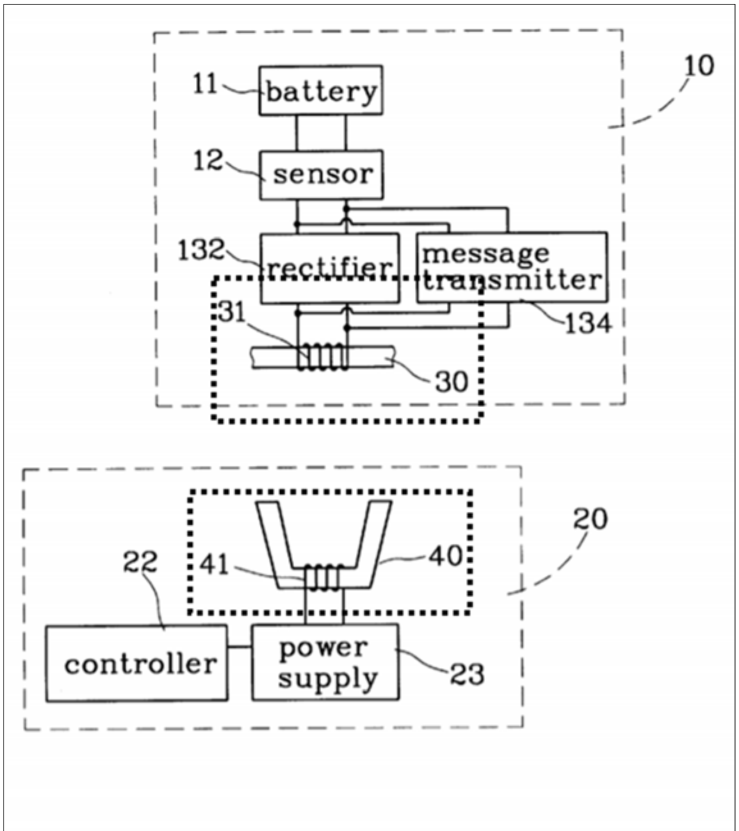


FIG.1

(*Id.*, FIG. 1 (annotated); Ex. PA-DEC, ¶212.)

A POSITA would have understood that an iron core (e.g., "iron core 30" and "iron core 40") is a magnetic material ("magnetic core piecepart") capable of coupling flux paths across the transformer. (Ex. PA-12, FIG 1, 3:40-49; *see also* Ex. PAT-A, 5:25-29 (disclosing that a magnetic core piecepart is "typically composed of . . . a soft ferrite, powered iron, or some other ferromagnetic substance with high magnetic permeability"); Ex. PA-8, 11:3-10, 13:3-5 (disclosing iron is a ferromagnetic substance with a high magnetic permeability); Ex. PA-DEC, ¶213.)

A POSITA would also have understood that the coils are metallic because they couple power to rectifier 132 and power supply 23, as shown in Figure 1. (Ex. PA-12, 2:53-56, 3:44-49,

FIG. 1; Ex. PA-DEC, ¶214.) To the extent *Chao* is read not to disclose metallic coils, using metallic coils, as explained above, (as opposed to another type of coil) would have been nothing more than an obvious substitution—a nonmetallic wireless power coil for a conventional, metallic wireless power coil—to obtain a predictable metallic coil implementation. *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Chao also discloses that the first magnetic core piecepart and second magnetic core piecepart, including their respective encircling coils are configured to be coupled to form a transformer for wireless power transfer to charge a battery. (Ex. PA-12, FIG. 1, 3:40-49 ("[T]he charging stage 20 comprises a primary iron core 40, primary coil 41 around the iron core 40, a power supply 23 connected to the primary coil 41, and a controller 22 connected to the power supply 23. The power supply is functioned to provide electrical energy to the charging device by supplying a magnetic flux over the primary iron core 40 with coil 41. The magnetic flux on the primary iron core 40 will induce current on the secondary coil 31 around the induced iron core 30, thus charging the battery 11."; Ex. PA-DEC, ¶215.)

In view of the above disclosure of *Chao*, it would have been obvious, and a POSITA would have been motivated, to have the first and second metallic coil of *Jeong* encircle a magnetic core piecepart as taught by *Chao*. (Ex. PA-DEC, ¶216.) As *Chao* teaches, "the shape and arrangement of the primary iron core 40 [is] such that the magnetic flux thereof has efficient coupling to the secondary iron core." (Ex. PA-12, 4:6-10.) A POSITA would have understood the benefits of using a magnetic core, as *Chao* teaches, and would have been motivated to improve the efficiency of *Jeong*'s transformer by using a similar magnetic core partially encircled by *Jeong*'s coils. (Ex. PA-DEC, ¶216.)

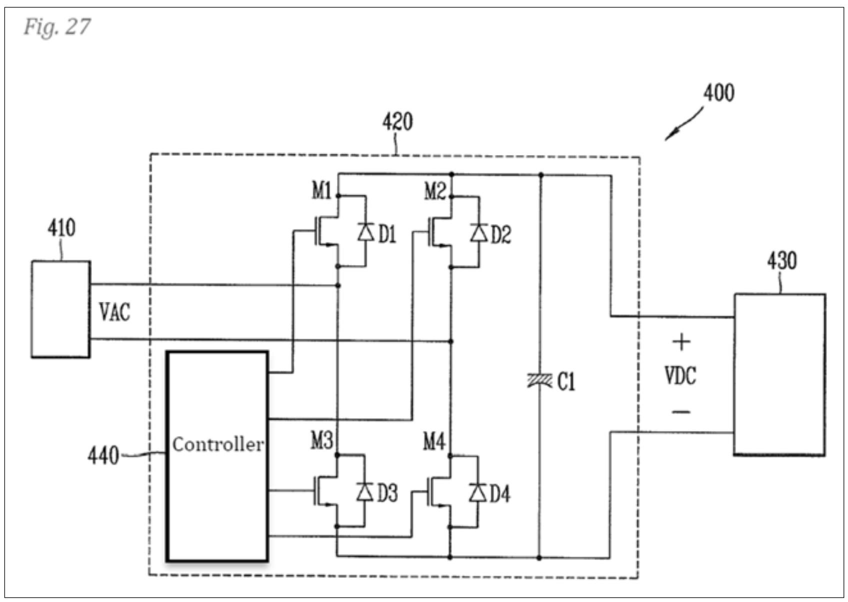
A POSITA implementing *Jeong*'s bidirectional wireless power transfer apparatus would have looked to *Chao* at least because *Chao* is in the same or similar technical field, related to wireless power transfer, and specifically, wireless power transfer between mobile phones as *Jeong*. (Ex. PA-12, 1:5-10 ("The present invention relates to a charging device for use with mobile phones, more particularly, to a contact-free type charging device for use with mobile phones, which delivers electrical energy to the mobile phone through magnetic induction."). Similar to *Jeong*, *Chao* discloses that the first magnetic core piecepart and corresponding coil is "configured to be coupled to, aligned with and removable from" the second magnetic core piecepart and corresponding coil. (Ex. PA-DEC, ¶¶217.) For example, the iron cores and coils are coupled through magnetic flux and physically aligned during wireless power transfer. (Ex. PA-12, FIG. 1 (illustrating aligned iron cores and coils); *id.*, 3:40-49 (explaining how the flux of the cores and coils are coupled during wireless power transfer); *id.*, 4:6-11 (noting that the cores and coils are aligned when transferring power).) Further, the iron cores and coils are removable from each other, as the mobile phone does not always need to charge, etc. (*Id.*, 1:5-10, 1:41-47, 2:33-39 (describing that the invention is applicable to a "mobile phone").)

Because of the similar applications and in view of a POSITA's skill and experience, a POSITA would have had a reasonable expectation of success in the combination described above, as the proposed modification would have combined known technologies (e.g., the known configuration of a magnetic core encircled by a metallic coil) according to known methods (e.g., using wireless power cores with surrounding coils to transmit/receive power) to yield the predictable result of a wireless power system wherein "first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer." *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Further, *Jeong* in view of *Chao* discloses or suggests the "magnetic core piecepart" under the District Court's construction, *see supra* Section V, where the "magnetic core piecepart" is a "core piece that is made of magnetic material," because as described above, a POSITA would have found it obvious to increase the power efficiency of the *Jeong* bidirectional power system by implementing an arrangement similar to that described in *Chao*, which utilizes iron core magnetic materials. Likewise, *Jang* in view of*Chao* discloses or suggests the "magnetic core piecepart" under the Board's construction, *see supra* Section V, where the "magnetic core piecepart" is "a magnetic part that cooperates with at least one other magnetic part to create a flux path that passes through the first and second metallic coils." (Ex. PA-DEC, ¶218.) As described above, a POSITA would have been motivated to improve the *Jang* bidirectional power system by implementing an arrangement similar to that described in *ChaoChao*, which utilizes iron core magnetic materials (two magnetic parts), each with inductive coil windings, which when positioned together cause flux paths to form through the coil windings.

c. [1.c] a battery metallically coupled to said first metallic coil and configured to be charged and discharged through an electrically isolating path of said transformer.

Jeong in view of *Chao* discloses or suggests this limitation. (Ex. PA-DEC, ¶¶219-223.) For example, *Jeong* discloses a charging unit 430, metallically coupled to the first metallic coil 410, and configured to be charged and discharged through the transformer formed between the first metallic coil/first magnetic core piecepart and the second metallic coil/second magnetic core piecepart. (Ex. PA-9, ¶[0359] ("the bidirectional transmission circuit unit (420) can be formed to convert the DC voltage input from the charging unit (430) into an AC voltage in discharge mode and output to the coil unit (410), or convert the AC voltage input from the coil unit (410) into a DC voltage in charge mode and output to the charging unit (430)").)



(*Id.*, FIG. 27.)

Although *Jeong*'s Figure 27 circuit shows bidirectional transmission circuit 420 between the charging unit 430 and coil 410, the '067 patent defines "metallic" to refer to "without limitation, an electrical connection between two separate parts that is a wired or a contact that may include electrically conductive components such as semiconductor devices as well as current-conducting components such as resistors and inductors." (Ex. PAT-A, 3:48-53; *see also id.*, 5:17-19 ("It should be understood that the connection between the metallic coil 160 and battery will include components therebetween.") Thus, circuit diagrams in *Jeong*'s Figure 27 shows "metallic" coupling, as that term is defined in the '067 patent.

Although *Jeong* does not call "charging unit (or load, [430])"[2] a "battery," or state that the charging unit is connected to a battery, it explains that "[t]he wireless power transceiver (400) [is] capable of bidirectional wireless power transmission [and] can transmit wireless power in **discharge mode**, and receive wireless power in **charge mode.**" (Ex. PA-9, ¶[0357].) A POSITA would have understood that *Jeong*'s discharge mode and charge mode would charge and discharge a battery based on that terminology and the other disclosures of *Jeong*, at least because *Jeong* does not disclose charging anything other than a battery. (Ex. PA-DEC, ¶221.) For example, *Jeong* repeatedly discusses wirelessly transmitting power to charge a battery. (*See, e.g.*, PA-9, ¶[0039] ("[T]he wireless power transmitter (100) may be a wireless charging device that **charges the battery** of the electronic device (200) by wirelessly transmitting power." (emphasis added)); *id.*, ¶[0093] ("The electronic device (200) receiving the power required for operation from the power supply unit (290) may operate on the power transmitted from the wireless power transmitter (100) or on the electric power from the battery (299) after **charging the battery** (299) using the transmitted power." (emphasis added)); *id.*, ¶[0251] ("The power supply unit (290) may be equipped with a battery (299) . . . and include **a charging unit** (298) **for** wired or wireless **charging of the battery** (299)." (emphasis added)); *id.*, ¶[307] ("electronic device (200) completely **charges its battery** using the transmitted power"); *id.*, ¶[320] ("The receiver side (or wireless power receiver) of the wireless power transmission system may include a receiver coil, rectifier, regulator, and a battery."); *id.*, FIG. 2(b) (showing charging unit 298 outputting power to battery 299).) Moreover, *Jeong* describes two embodiments and refers to the bi-directional embodiment as "the second embodiment of the present invention." (*Id.*, ¶[0356].) *Jeong* explains that the Fig. 2(b) block diagram is "adoptable to the embodiments disclosed in the present specification" (*i.e.*, would be adoptable to the second embodiment) and shows charging unit 298 charging battery 299. (*Id.*, FIG. 2(b), ¶¶[0092], [0093] ("charging the battery (299) using the transmitted power"). Thus, *Jeong* discloses or suggests charging and discharging a battery metallically coupled to the first metallic coil. (Ex. PA-DEC, ¶221.)

Jeong discloses that its wireless power system can transfer power "bidirectional[ly]" between two wireless power transceivers (400), and that "coil unit (410) may be formed to transmit

[2] In paragraph [0357], *Jeong* erroneously references the charging unit as "(420)," instead of "(430)." The surrounding discussion makes clear that this is a typographical error. (*See, e.g.*, Ex, Jeong, ¶¶ [0359], [0361] ("charging unit (430)"; "bidirectional transmission circuit unit (420)").)

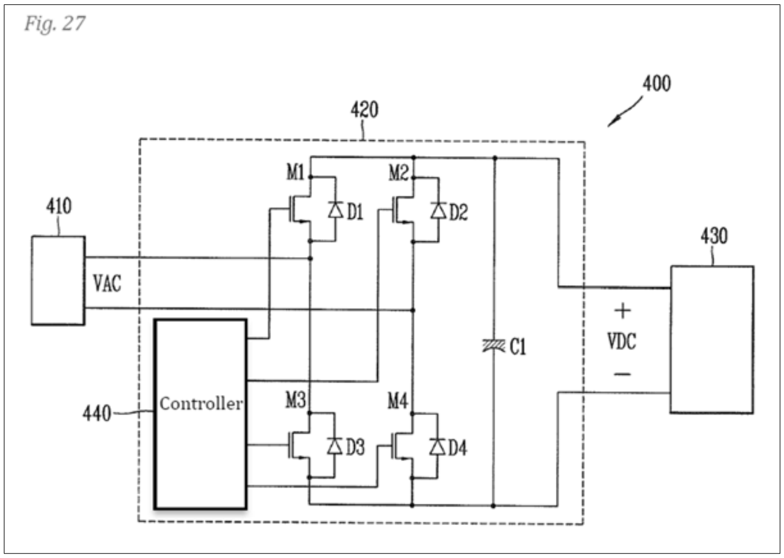
or receive wireless power. (PA-9, ¶¶[0356]-[358].) Thus, the battery described above is coupled to coil unit 410 ("first metallic coil") and is configured to be "charge[d]" and "discharge[d]," *id.*, ¶¶[0357], [0359], by transferring or receiving power through that coil unit as shown in Figure 26. (PA-DEC, ¶¶222.) Although *Jeong* does not use the term "transformer," a POSITA would understand the coupled coils of Figure 26 to be a transformer. (*Id.*, FIG. 26, ¶¶[356]-[361], PA-DEC, ¶¶222.)

To the extent *Jeong* does not explicitly disclose a battery, this feature would have been obvious, and a POSITA would have been motivated to implement it. (Ex. PA-DEC, ¶223.) *Jeong* describes "charging" and "discharging," as described above. (Ex. PA-9, ¶¶[0357], [0359].) And a POSITA would have understood a battery to be a suitable device, and indeed one of the only devices (besides a capacitor), that can be charged and discharged. (PA-DEC, ¶¶223.) Indeed, *Jeong* explicitly discloses charging a battery, as described above. Thus, it would have been obvious before the time of invention for the disclosed charging and discharging to be charging and discharging a battery. (*Id.*) A POSITA would have had a reasonable expectation of success in such an implementation, as the proposed modification would have combined known technologies (e.g., *Jeong*'s bi-directional charging apparatus and a battery) according to known methods (e.g., wireless charging and discharging) to yield the predictable result of a wireless power system configured to charge and discharge a battery. (*Id.*) It would also have been obvious to try, because a POSITA would have merely needed to select a battery from a known, finite number of predictable options for devices that can be charged or discharged (e.g., a battery and a capacitor) to select a battery amongst those limited options. (*Id.*) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

4. Claim 7

a. The apparatus as recited in claim 1 further comprising a power train including a first switching circuit coupled to said first metallic coil configured to form a portion of a resonant topology with a second switching circuit coupled to said second metallic coil.

Jeong discloses these limitations. (Ex. PA-DEC, ¶¶224-225.) For example, "the bidirectional transmission circuit (420)" ("power train") "can include a bridge circuit" ("including a first switching circuit") that is coupled to coil unit 410 ("said first metallic coil"). (Ex. PA-9, ¶[0362]; *see also id.*, ¶[0357], ¶[363], FIG. 27.) "Referring to Fig. 27, the bridge circuit can include the first through fourth switches (M1, M2, M3, M4) each formed of a MOSFET." (*Id.*, ¶[0363].)



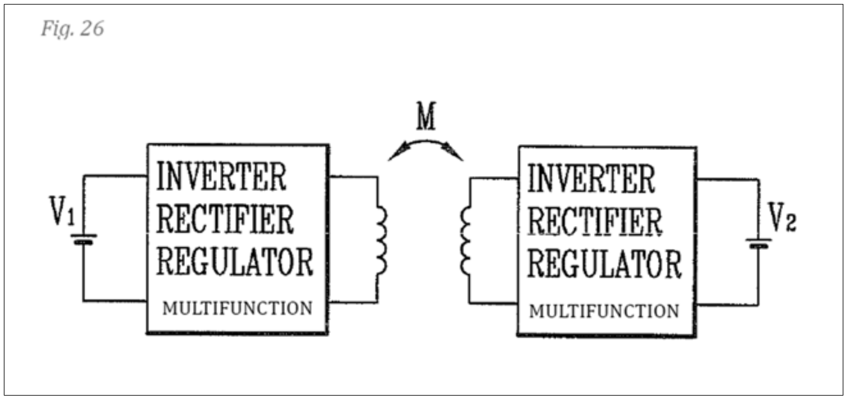
(*Id.*, FIG. 27.)

Jeong further discloses "[t]he coil unit (410) includes a coil and a capacitor forming a **resonant circuit** with the coil, and may be formed to receive or transmit wireless power from the wireless power transceiver (400)." (*Id.*, ¶[0358] (emphasis added).) Because *Jeong* discloses "a pair of wireless power transceivers (400) having the same structure form a wireless power transmission system," the circuit on the opposite side of the transformer formed by first coils 410 and second coil 410 would have the same structure as shown in Figure. 27. (Ex. PA-9, ¶[0357]; *see also id.*, ¶[0356].) That would include a second bridge circuit including a second set of switches M1-M4 ("second switching circuit") coupled second coil 410, and a capacitor forming a resonant circuit with the coil. (Ex. PA-9, ¶¶[358], [0363], FIGs. 26, 27.) Therefore, *Jeong* discloses a first switching circuit coupled to a first metallic coil configured to form a portion of a resonant topology with a second switching circuit coupled to said second metallic coil.

5. Claim 15

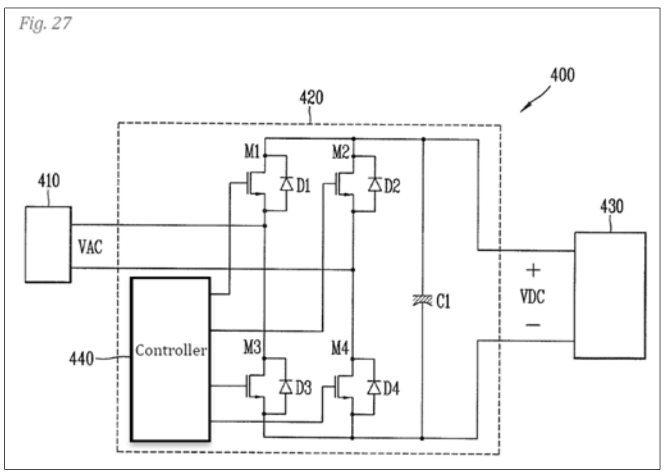
a. [15.a] A system, comprising:

To the extent the preamble is limiting, *Jeong* discloses this limitation. For example, *Jeong* discloses a bidirectional wireless power system ("a system"). (Ex. PA-9, FIG. 26; *id.*, ¶[0028] (emphasis added) ("Fig. 26 is a conceptual diagram of the wireless power transmission system in which bidirectional transmission of wireless power is possible.").)



(*Id.*, FIG. 26.)

Jeong further discloses "a pair of wireless power transceivers (400) having the same structure form a wireless power transmission system." (Ex. PA-9, ¶[0357].) One of the pair of transceivers 400 is shown in Figure 27. (Ex. PA-9, ¶¶[0356], FIG. 27.)



(*Id.*, FIG. 27.)

"The wireless power transceiver (400) capable of bidirectional wireless power transmission can transmit wireless power in discharge mode, and receive wireless power in charge mode." (Ex. PA-9, ¶[0357].) "[W]hen a pair of wireless power transceivers (400) having the same structure form a wireless power transmission system, one of the wireless power transceivers (400) can operate in discharge mode, and the other wireless power transceiver (400) operate in charge mode." (*Id.*) In other words, *Jeong* discloses that the Figure 26 system comprises two of the Figure 27 apparatuses that can be coupled to form a bidirectional wireless power system as shown in Figure 26. (Ex. PA-9, FIG. 26; *id.*, ¶[0356]-[0357], ¶[0028] ("Fig. 26 is a conceptual diagram of the wireless power transmission system in which **bidirectional transmission of wireless power** is possible.") (emphasis added); ¶[0006] (An objective of the invention is "to provide a wireless power system, which is capable of bi-directionally transmitting wireless power via a wireless transmission system configured with a pair of wireless power transceivers in identical structures").)

b. [15.b] a wireless battery interface including a wireless battery interface magnetic core piecepart; and a wireless battery, including: a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer; and

Jeong in view of *Chao* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶226-228; *see also supra* Section VII.K.3.) Claim 15 largely tracks claim 1, except that it recites a system instead of an apparatus, and uses different nomenclature. As detailed below, the "wireless battery" refers to the circuit on the side of the transformer connected to a battery (claimed "wireless battery including . . . a battery"), and the "wireless battery interface" is on the other side of the transformer, and need not include a battery. (Ex. PAT-A, Claim 15; *see also id.*, 5:20-22 ("FIG. 2 illustrate[s] . . . a schematic diagram of an embodiment of a power system with a wireless battery 200 and a wireless battery interface 250.").)

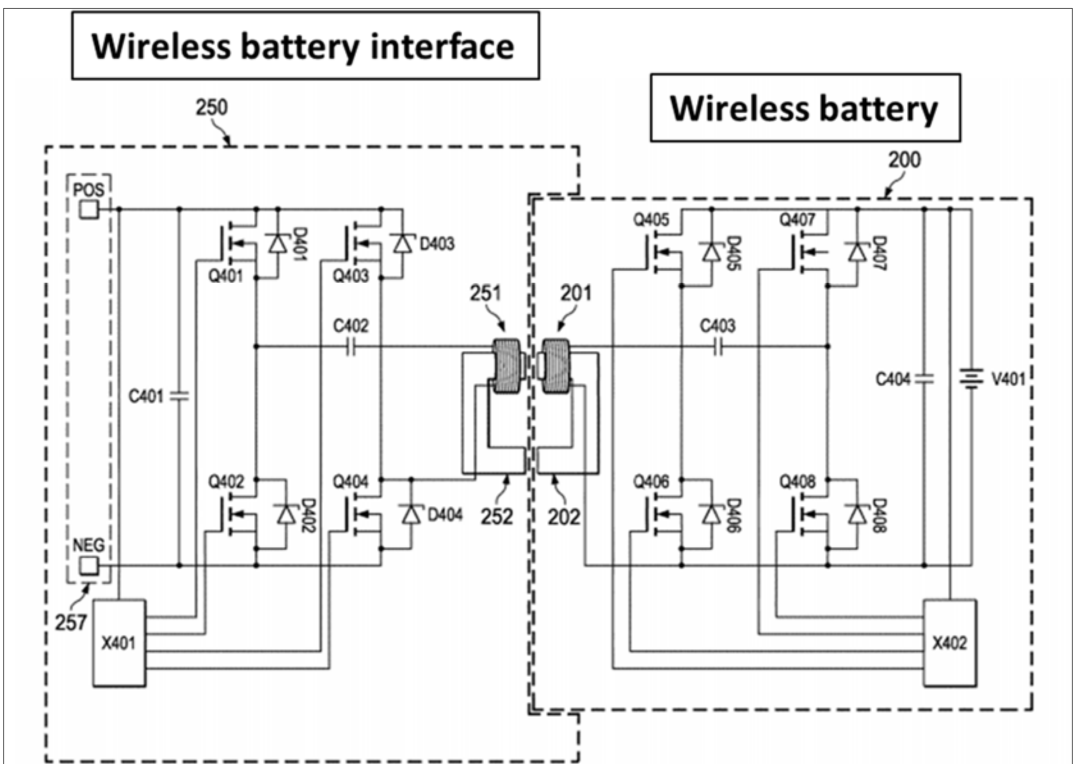
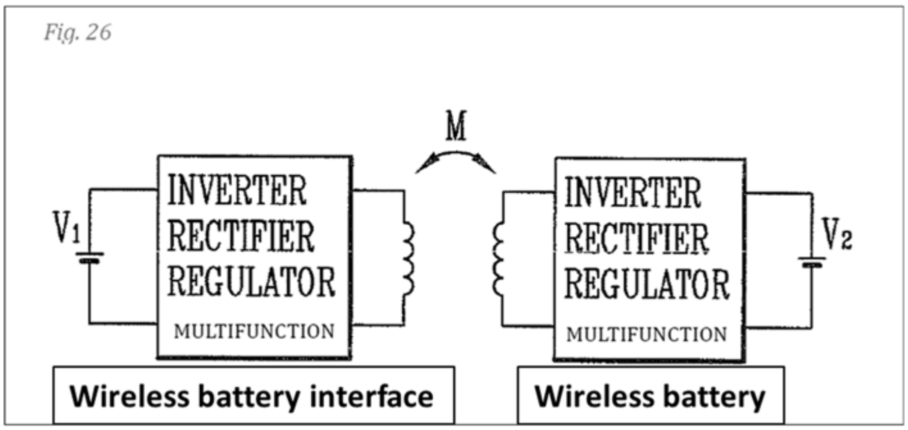


FIG. 2

(*Id.*, FIG. 2 (annotated); Ex. PA-DEC, ¶229.)

Jeong discloses the claimed wireless battery interface and wireless battery. Annotated Figure 26 below provides an example, but this same nomenclature applies to *Jang*'s other figures and disclosures. *Jeong* discloses that its bidirectional wireless power system transfers power between a "pair" of power transceivers 400, one of which is "a wireless battery interface" and the other is "a wireless battery." (Ex. PA-9, ¶[0357], FIG. 26 (illustrating that the system includes a pair of inverter-rectifier-regulators).)



(Ex. PA-9, FIG. 26 (annotated); Ex. PA-DEC, ¶230.) As described for claim elements 1[b] and 1[c], *supra* Section VII.K.3.b-c, *Jeong* in view of *Chao* discloses or suggests these limitations. The Figure 25/26 load is disclosed or suggested to be a battery, *supra* Section VII.K.3.c, and this load is a part of the wireless battery as illustrated above. (Ex. PA-DEC, ¶230.) *Jeong* in view of *Chao* discloses the claimed magnetic core pieceparts which are "configured to be coupled to, aligned with and removable from" each other. (*Supra* Section VII.K.3.b.) And as explained with respect to annotated Figure 26 above, each of the wireless battery interface and wireless battery includes a magnetic core piecepart as claimed to form the wireless transformer. (*Id.*, FIG. 26; *supra* Section VII.K.3.b.) Further, *Jeong* in view of *Chao* discloses the "magnetic core piecepart" under both the District Court and Board's constructions for similar reasons as explained for claim 1 in *supra* Section VII.K.3. (Ex. PA-DEC, ¶230.)

c. [15.c] a wireless battery, including: . . . a battery metallically coupled to a first metallic coil encircling at least a portion of said wireless battery magnetic core piecepart and configured to be charged and discharged through an electrically isolating path of said transformer.

Jeong in view of *Chao* discloses or suggests these limitations. (Ex. PA-DEC, ¶231.) As discussed for claim elements 1[b], 1[c], and 15[b], *supra* Sections VII.K.3.b-c, VII.A.6.b, *Jeong* discloses a first metallic coil (410), with a battery metallically coupled to the first metallic coil. And as discussed above for claim element 1[c], *supra* Section VII.K.3.b-c, the battery in *Jeong*'s bidirectional wireless power transfer system is configured to be charged and discharged through an electrically isolating path of *Jeong*'s transformer (discussed in claim 1 with reference to the apparatus).

6. Claim 16

a. The system as recited in claim 15 further comprising a power train including a first switching circuit of said wireless battery configured to form a portion of a resonant topology with a with a second switching circuit of said wireless battery interface.

Jeong and *Chao* disclose or suggest the limitations of claim 16 for the same reasons presented above for claims 7 and 15. (*See supra* Section VII.K.4, 5; Ex. PA-DEC, ¶232.)

L. SNQ12: *Jeong* in view of *Chao* and *Yang* Renders Obvious Claim 8

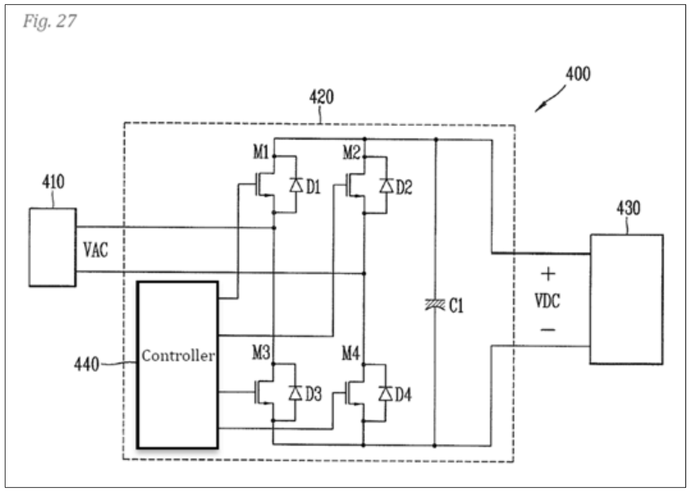
As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Chao* and further in view of *Yang* discloses or suggests the limitations of claim 8 of the '067 patent. (Ex. PA-DEC, ¶¶233-243.)

1. Claim 8

a. The apparatus as recited in claim 7 further comprising a controller configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level.

Jeong in view of *Chao* and *Yang* discloses or suggests the limitations of claim 8. (Ex. PA-DEC, ¶234-243.) As discussed above, *Jeong* in view of *Chao* teach the elements of claim 7. (*See supra* Section VII.K.4; Ex. PA-DEC, ¶234.)

Jeong discloses a power power train comprising a full bridge circuit, as described above for claim 7. (*See supra* Section VII.K.4; Ex. PA-DEC, ¶235.) For example, *Jeong*'s "bidirectional transmission circuit (420)" ("power train") "can include a bridge circuit" ("including a first switching circuit") that is coupled to coil unit 410 ("said first metallic coil"). (Ex. PA-9, ¶[0362]; *see also id.*, ¶[0357], ¶[363], FIG. 27.) "Referring to Fig. 27, the bridge circuit can include the first through fourth switches (M1, M2, M3, M4) each formed of a MOSFET." (*Id.*, ¶[0363].)



(*Id.*, FIG. 27.)

Jeong further discloses that controller 440 controls the switches M1-M4 forming the bridge. (*Id.*, ¶[0366] ("[T]he gates of the first through fourth switches (M1, M2, M3, M4) are each connected to the control unit (440) and **the switches can be controlled by the control unit (440)**." (emphasis added)), ¶[368] ("the control unit (440) can **turn off the third and fourth switches** (M3, M4) in order for the bridge circuit to perform rectification. And, the control unit (440) can **turn on the third or fourth switches** (M3, M4) in order for the bidirectional transmission circuit unit (420) to perform adjustment.") (emphasis added)).) The control unit 440 also senses a voltage and can respond to the sensed by operating the switches. (*Id.*, ¶368 ("For example, when the wireless power transceiver (400) operates in charge mode again, the **control unit (440) senses the current or voltage received from the coil** unit (410); and turn the third or fourth switch (M3, M4) off or on.").)

Although *Jeong*'s bidirectional power transmission circuit 420 has a full-bridge circuit and control circuit for controlling the switches in that bridge circuit, it does not expressly disclose that its controller is configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level. (Ex. PA-DEC, ¶237.) However, it would have been obvious to a POSITA to modify *Jeong* to include this limitation in view of the in view of the teachings of *Yang*. (*Id.*)

Yang discloses a "resonant power converter with half bridge and full bridge operations and a method for control," where an "input signal is correlated to the input voltage of the full bridge circuit, where the full bridge circuit is operated as a full bridge switching when the input signal is lower than a threshold, and the full bridge circuit is operated as a half bridge switching when the input signal is higher than the threshold." (Ex. PA-3, Abstract; *see also id.*, 1:43-45 ("The control circuit coupled to receive a feedback signal and an input signal generates switching signals.")

Yang is in the same or similar technical field as *Jeong* at least because, like *Jeong*, *Yang* relates to power converter topologies. (Ex. PA-9, ¶[0360] ("[T]he bidirectional transmission circuit unit (420) can be formed to function as a rectifier as well as a DC/DC converter in charge mode."); Ex. PA-3, Abstract ("A resonant power converter with half bridge and full bridge operations and a method for control thereof are provided.").)

Yang is also in the same technical field as the '067 patent. (Ex. PAT-A, 17:52-54 ("[V]arious power converter topologies are well within the broad scope of the present invention."); *id.*, 3:23-24 ("The power system will be described as a switched-mode power supply or power converter."); *id.*, 4:37-41 ("The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by the metallic contact battery power systems."); Ex. PA-DEC, ¶240.) And *Yang* is reasonably pertinent to problems associated with power converter operating voltages and efficiency, problems with which the inventor was involved. (Ex. PA-3, 1:26-34 ("The drawback of the resonant power converter is its narrow operation range. It cannot be operated in a wide input voltage range. . . . The object of the present invention is to provide a control scheme to solve this problem. It allows the resonant power converter can be operated in wide input range."); *id.*, 5:53-55 ("Therefore, a higher efficiency and wider operation range for the power converter are achieved."); Ex. PAT-A, 7:22-26 ("The controller X401 can therefore be configured to selectively cause at least a portion of the power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level (e.g., the voltage at the terminals 257)."); *id.*, 4:37-41 ("The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by the metallic contact battery power systems.").)

Like *Jeong*'s power transmission circuit 420 shown in Figure 27, *Yang* discloses a "power train" that includes a bridge circuit. For instance, *Yang* discloses transistor switches 20, 25, 30, 35 as well capacitors 45 and 85, an inductive device 10, and rectifiers 81 and 82. (Ex. PA-3, FIG. 1, 2:24-40.) Together, these components form a power train that is used to convert voltages. (*Id.*, 2:24-40 ("FIG. 1 shows a power converter in accordance with a preferred embodiment of the present invention. . . . The switching frequency of the switching signals S_A, S_B, S_C, S_D is varied in accordance with a feedback signal VFB for regulating the output V_O.").) Moreover, the transistor switches 20, 25, 30, and 35 form a conventional "full bridge circuit." (*Id.*, 2:24-29, FIG. 1.)

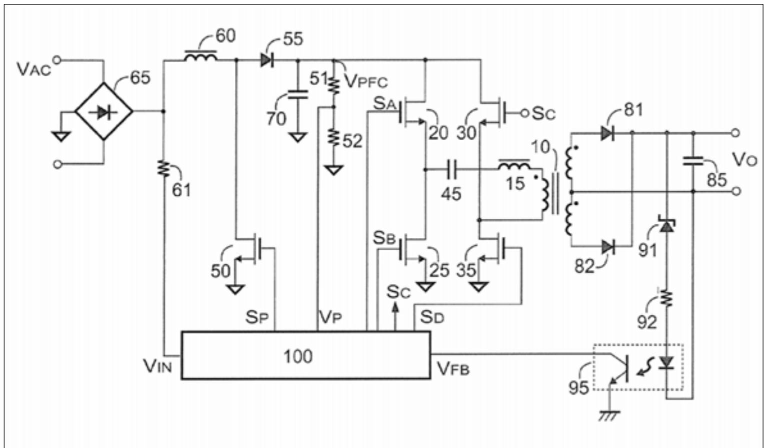


FIG. 1

(*Id.*, FIG. 1.)

Yang also discloses that the resonant power converter includes the full bridge circuit, a "control circuit and a PFC circuit" ("controller"). (*Id.*, 1:40-42.) And the control circuit is configured to switch the bridge circuit between operating in a full-bridge mode and a half-bridge mode based on a sensed voltage ("configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level"). (*Id.*, 2:44-61, 3:4-12.) For instance, *Yang* discloses that the "control circuit [is] coupled to receive a feedback signal and an input signal generates switching signals. The feedback signal is correlated to an output of the power converter and the input signal is correlated to an input voltage of the full bridge circuit, where the full bridge circuit is operated as a full bridge switching when the input signal is lower than a threshold, and the full bridge circuit is operated as a half bridge switching when the input signal is higher than the threshold." (*Id.*, 1:40-52; *see also id.*, 2:44-61 ("The full bridge circuit is operated as a full bridge switching when the input signal VP is lower than a threshold. The full bridge circuit is operated as a half bridge switching when the input signal VP is higher than the threshold.").) Moreover, "[t]he full bridge circuit will operate the full bridge switching when its input voltage V is low. The half bridge switching will be performed when its input voltage V, is high. The PFC circuit is not necessary to produce a high output voltage when the line input voltage V, is low. Therefore, a higher efficiency and wider operation range for the power converter are achieved." (*Id.*, 5:39-56.)

In view of the above disclosure of *Yang*, it would have been obvious, and POSITA would have been motivated, to use a controller to switch from a full-bridge to a half-bridge operation mode in *Jeong*'s apparatus, as taught by *Yang*. Such an arrangement would have provided the benefit, disclosed by *Yang*, of achieving higher efficiency and a wider operation range for the power converter. (*Id.*, 5:54-56.) Moreover, a POSITA would have recognized that using a controller to switch from full-bridge to half-bridge operation of *Jeong*'s bridge circuit would be a combination of known prior art elements according to known methods to yield the predictable result of changing the switch circuit operating method in response to voltage fluctuating. Further, a POSITA would have had a reasonable expectation of success at least because *Jang* discloses that its rectifier can be configured to operate using either a full bridge or half bridge circuit for bi-directional power flow. (Ex. PA-DEC, ¶243; Ex. PA-1, 7:5-14; FIGs. 9, 10.) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

M. SNQ13: *Jeong* in view of *Chao* and *Kardolus* Renders Obvious Claim 9

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Chao* and further in view of *Kardolus* discloses or suggests the limitations of claim 9 of the '067 patent. (Ex. PA-DEC, ¶¶244-253.)

1. Claim 9

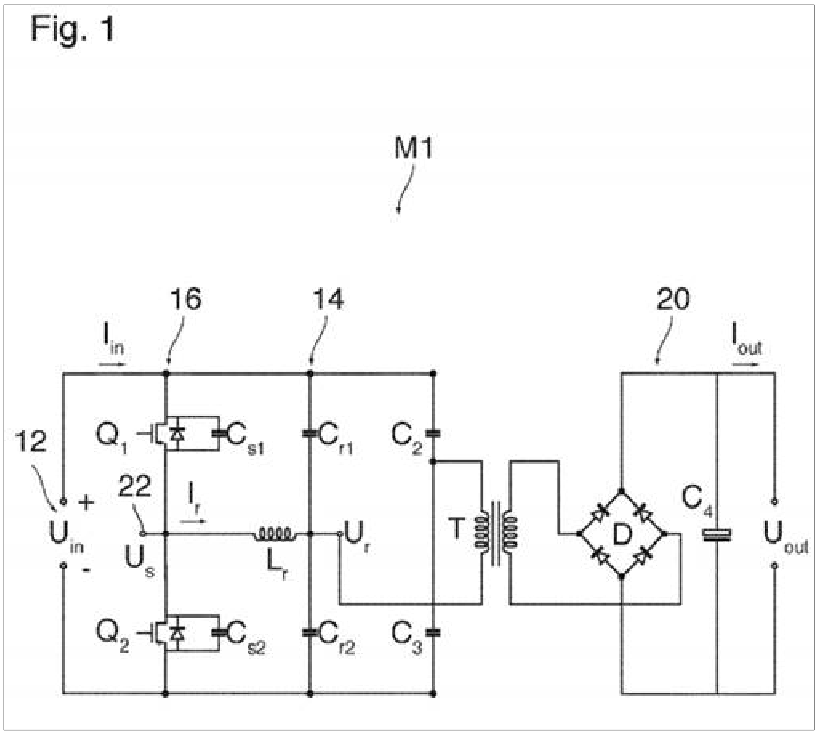
a. The apparatus as recited in claim 7 wherein said power train is configured to be intermittently operated in a burst mode of operation to control a characteristic of said battery.

Jeong in view of *Chao* and *Yang* discloses or suggests the limitations of claim 9. (Ex. PA-DEC, ¶¶245-253.) As discussed above, *Jeong* in view of *Chao* discloses or suggests the features of claim 7. (*Supra* Section VII.K.4; Ex. PA-DEC, ¶¶245.)

Jeong discloses an apparatus wherein the battery is charged and discharged through the power train, and specifically through the first switching circuit connected to the first metallic coil. (*See supra* Sections VII.K.3-4.) *Jeong* does not describe operating its switching circuits in a "burst mode" of operation, but it would have been obvious to a POSITA to modify *Jeong* to include this limitation in view of the teachings of *Kardolus*. (Ex. PA-DEC, ¶246.)

Kardolus discloses a "battery charger for electric vehicles," including a "power converter module," (Ex. PA-4, Abstract, ¶[0007]), in which a "sequence of ON pulses of both switches [Q_1 and Q_2] is chopped into **bursts** 40 that are **separated by breaks** 42" ("power train is configured to be intermittently operated in a burst mode of operation") to "reduce the output current I_{out}" ("to control a characteristic of said battery"). (*Id.*, Abstract, ¶¶[0056]-[0058] (emphasis added).)

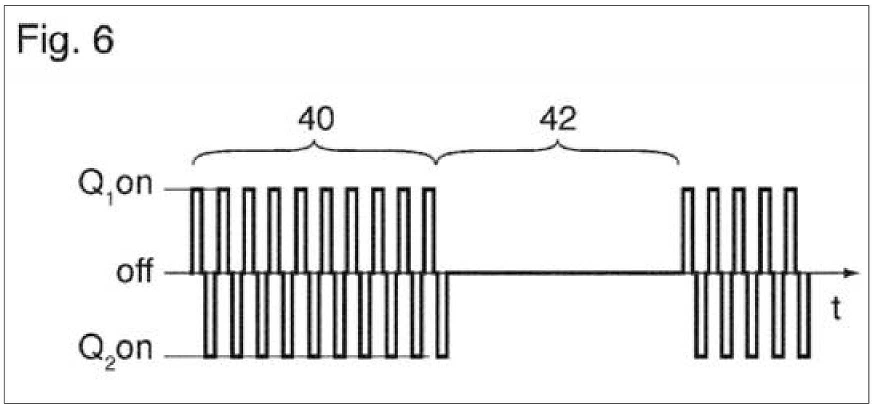
The battery charger of *Kardolus* is shown in Figure 1. (Ex. PA-4, FIG. 1; Ex. PA-DEC, ¶248).



(*Id.*, FIG. 1.)

The resonant power converter M1 in Figure 1 "is arranged to convert an input voltage U_{in} into a DC output voltage U_{out}, which will be equal to the battery voltage" (for a corresponding battery load). (*Id.*, ¶[0030].) The switches Q_1 and Q_2 form half bridge 16, and are opened and closed at a given frequency to generate voltage U_r, which "drives the primary side of a transformer T." (*Id.*, ¶¶[0031]-[0034].) The switching frequency of switches "Q1 and Q2 is varied in order to comply with varying demands for output current I_{out}." (*Id.*, ¶[0045].) For example, the switching frequency is increased to reduce the output current I_{out}. (*Id.*, ¶[0056].) However, if the switching frequency is increased too much (to generate a low output current I_{out}), "a point will be reached where the switching frequency must be so high that . . . the residual switching losses would become predominant." (*Id.*)

As a solution to the problem of predominant residual switching losses, *Kardolus* discloses operating the switches in a "burst" mode of operation. (*Id.*, ¶¶[0056]-[0058].) *Kardolus* describes this "mode of operation, wherein the sequence of ON pulses of both switches [Q_1 and Q_2] is chopped into bursts 40 that are separated by breaks 42.") (*Id.*, ¶[0058].) "In this way, power transfer may be reduced to 50% or even less," ensuring that "the resulting ripple in output current will be negligible." (*Id.*) The switching sequence of the "burst" "mode of operation" is shown in Figure 6.



(*Id.*, FIG. 6.)

In view of the above disclosures of *Kardolus*, it would have been obvious, and a POSITA would have been motivated, to configure *Jeong*'s power train to operate in a burst mode of operation where the sequences of on pulses of its switches are chopped into bursts and separated by breaks. As *Kardolus* teaches, a burst mode of operation is useful to reduce the power output from the switching circuit while preventing switching losses from becoming predominant. (*Id.*, ¶[0058].) A POSITA would have recognized that such a problem would also occur in *Jeong*'s switching circuits, when, like in *Kardolus*, the power transmitted through the switching circuit is decreased to an amount below what is efficient to transfer through a normal switching mode.

As the switching circuit of *Jeong*'s power train is used to charge and discharge a battery through a transformer, *see supra* Section VII.K.3-4, implementing a burst mode to decrease output current and improve efficiency in *Jeong*'s power train would also control a characteristic of *Jeong*'s battery (*e.g.,* the current output from the switching circuit of the power train to the battery). (Ex. PA-DEC, ¶252.)

A POSITA would have had a reasonable expectation of success in such an implementation, as the proposed modification would have combined known technologies (e.g., *Jeong*'s known wireless power converter with a switching circuit) according to known methods (e.g., operating a switching circuit in a burst mode to control the output) to yield the predictable result of intermittently operating the power train in a burst mode to control a characteristic of the battery. *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Further, *Jeong* in view of *Chao* and *Kardolus* discloses or suggests the "burst mode of operation" as construed by the District Court, *see supra* Section V, to mean "a mode of operation wherein the power train is periodically activated and deactivated" because as described above, a POSITA would have found it obvious to configure *Jeong*'s power train to operate in a burst mode of operation, as taught by *Kardolus*, so that the sequences of on pulses of its switches are separated by breaks, i.e., periodically activated and deactivated. (Ex. PA-DEC, ¶253.)

N. SNQ14: *Jeong* in view of *Chao* and *Lee* Renders Obvious Claims 10 and 11

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Chao* and further in view of *Lee* discloses or suggests the limitations of claims 10 and 11 of the '067 patent. (Ex. PA-DEC, ¶¶254-262.)

1. Claim 10

a. The apparatus as recited in claim 7 further comprising a capacitor selected to produce substantially zero-current switching of said first switching circuit in said power train in conjunction with an inductor.

Jeong in view of *Chao* and *Lee* discloses or suggests the limitations of claim 10. (Ex. PA-DEC, ¶¶255-261.) As discussed above, *Jeong* in view of *Chao* teach the elements of claim 7. (*See supra* Section VII.K.4.)

Jeong further discloses coil unit 410 "includes a coil" ("an inductor") and "capacitor forming a resonant circuit with the coil, and may be formed to receive or transmit wireless power from the wireless power transceiver (400)." (Ex. PA-9, ¶[358].) A POSITA would have understood *Jeong*'*s* "coil" to be an inductor at least because it is drawn as an inductor in Figure 26 (Ex. PA-9, FIG. 26), and because a POSITA would readily recognize a coil for use in power transfer as a form of inductor. (Ex. PA-DEC, ¶256.) *Jeong* also discloses that the "[t]he control unit (440) may perform soft switching such as ZVS (Zero Voltage Switching) or **ZCS (Zero**

Current Switching) by sensing the current or voltage received from the coil unit (410) and changing the state of the third or fourth switch (M3, M4)." (Ex. PA-9, ¶[370] (emphasis added).) To the extent *Jeong* does not explicitly disclose "a capacitor selected to produce substantially zero-current switching of said first switching circuit in said power train in conjunction with an inductor," it would have been obvious to a POSITA to modify *Jeong* to implement such features in view of *Lee*.

In a similar power converter art, *Lee* teaches a family of quasi-resonant converters, "employing switches that turn on and off at zero current conditions." (Ex. PA-6, 3:38-44.) Specifically, *Lee* discloses "**[t]he impedances of the resonant capacitor and the resonant inductor are selected** to establish a resonating current waveform on the resonant inductor **to apply zero-current conditions to the switch at turn on" and turn off** ("a capacitor selected to produce substantially zero-current switching . . . in conjunction with an inductor "). (Ex. PA-6, 3:66-4:4 (emphasis added); *see also id.*, Abstract.) *Lee* further discloses that "the **impedances of the resonant capacitor and the resonant inductor are selected** . . . to ensure that the current waveform imposed on the switch by the resonant inductor is at **substantially zero current**, when the switch is next disposed to its second or off state." (*Id.*, 4:5-11.)

In view of the above disclosure of *Lee*, it would have been obvious, and a POSITA would have been motivated, to select a capacitor, such as *Jeong*'s capacitor in coil unit 410, to produce substantially zero-current switching in *Jeong*'s bridge circuit (the "first switching circuit") in conjunction with the coil ("an inductor"). (Ex. PA-DEC, ¶258.) As *Lee* explains, zero current switching "eliminate[s] switching stresses and losses," and overcomes a problem with the prior art where "the DC voltage conversion ratio is sensitive to load variations." (Ex. PA-6, 3:31-51.) A POSITA would have understood that these benefits would have applied equally to *Jeong*'s converter topology, and indeed would have understood that eliminating switching stresses and losses would be beneficial to any converter. (Ex. PA-DEC, ¶258.)

Additionally, a POSITA would have recognized that *Jeong* already uses a converter having a topology similar to those contemplated by *Lee*. (Ex. PA-DEC, ¶259.) For example, *Lee* discloses that one difference between its converter design and a prior art converter is that the switch "and diode are coupled in anti-parallel with each other to form a parallel circuit, which is in turn connected to the resonant inductor and the resonant capacitor." (Ex. PA-6, 4:15-25, 4:31-39; Ex. PA-DEC, ¶259.) *Jeong* discloses the same configuration. (Ex. PA-9, FIG. 27 (showing antiparallel diodes connected in parallel with switches M1-M4, and connected to coil unit 410), ¶[358] ("coil unit (410) includes a coil and a capacitor forming a resonant circuit with the coil").)

Moreover, *Jeong* already discloses zero current switching, as described above (Ex. PA-9, ¶[370]), and thus *Lee* would merely inform a POSITA how to implement such a feature in *Jeong*. (Ex. PA-DEC, ¶260.)

A POSITA would have had a reasonable expectation of success in the combination, and the combination would have been well within the level of skill of a POSITA. (Ex. PA-DEC, ¶261.) Combining *Jeong*'s converter topology that is capable of performing zero current switching, as *Jeong* discloses, with *Lee*'s teaching of selecting a capacitor and inductor to effect zero current switching together would have been nothing more than combining known prior art element according known methods to yield the predictable result of substantially zero current switching. (*Id*.)

2. Claim 11

a. The apparatus as recited in claim 10 wherein said inductor is formed at least in part with said first metallic coil.

Jeong in view of *Chao* and *Lee* discloses or suggests the limitations of claim 11. (Ex. PA-DEC, ¶262.) As discussed above for claim 10 (*see supra* Section VII.N.1), *Jeong* in view of *Chao* and *Lee* disclose the limitations of claim 10. As previously explained in *Jeong*, the coil of coil unit 410 ("said first metallic coil") discloses the inductor of claim 10 and therefore also discloses "said inductor is formed at least in part with said first metallic coil." (*See supra* Section VII.N.1; Ex. PA-DEC, ¶262.)

O. SNQ15: *Jeong* in view of *Chao* and *Madawala* Renders Obvious Claims 12 and 17

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Chao* and further in view of *Madawala* discloses or suggests the limitations of claims 12 and 17 of the '067 patent. (Ex. PA-DEC, ¶¶263-276.)

1. Claim 12

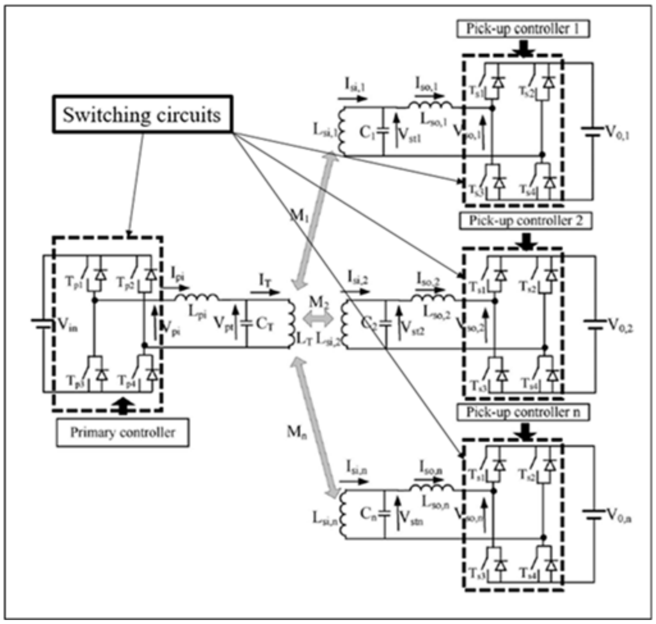
a. The apparatus as recited in claim 7 wherein said power train is configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit.

Jeong in view of *Chao* and *Madawala* discloses or suggests the limitations of claim 12. (Ex. PA-DEC, ¶¶264-272.) As discussed above, *Jeong* in view of *Chao* teaches the elements of claim 7. (*See supra* Section VII.K.4.) And as discussed above for claim element 1[c], *Jeong* discloses an apparatus configured to enable a battery to be charged and discharged through a transformer. (*Supra* Section VII.K.3.c.)

While *Jeong* does not explicitly disclose that the power train is configured to enable said battery to be "successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit," it would have been obvious to a POSITA to modify *Jeong* to implement such features in view of *Madawala*. (Ex. PA-DEC, ¶¶265.)

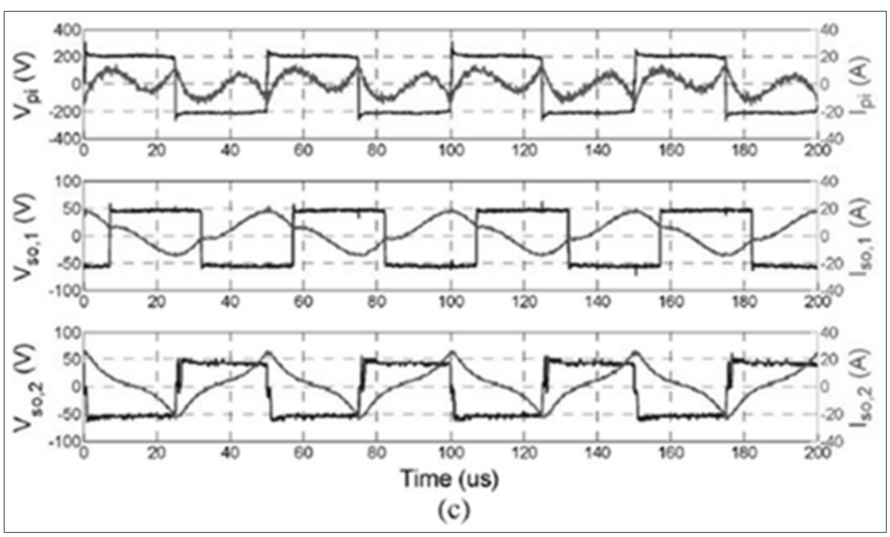
Madawala generally relates to "a bidirectional inductive power interface," and inductive power transfer, like *Jeong*. (Ex. PA-11, 4790 ("This paper proposes a novel current-sourced bidirectional IPT power interface, which is suitable for simultaneous contactless/discharging of multiple EVs or equipment."); *id.*, Abstract ("Demand for supplying contactless or wireless power for various applications, ranging from low-power biomedical implants to high-power battery charging systems, is on the rise. Inductive power transfer (IPT) is a well recognized technique through which power can be transferred from one system to another with no physical contacts. This paper presents a novel bidirectional IPT system."); Ex. PA-9, ¶[0044] ("[T]he wireless power transmitter (100) can transmit power using one or more methods between an inductive coupling method based on an electromagnetic induction phenomenon generated by the wireless power signal.") Thus, like *Jeong*, *Madawala* relates to transferring power wirelessly between devices, and a POSITA would have been interested in considering the teachings of *Madawala* when implementing *Jeong*.

Also like *Jeong*, *Madawala*'s bi-directional apparatus is configured to transfer power across a transformer, using switching circuits on each side of the transformer.

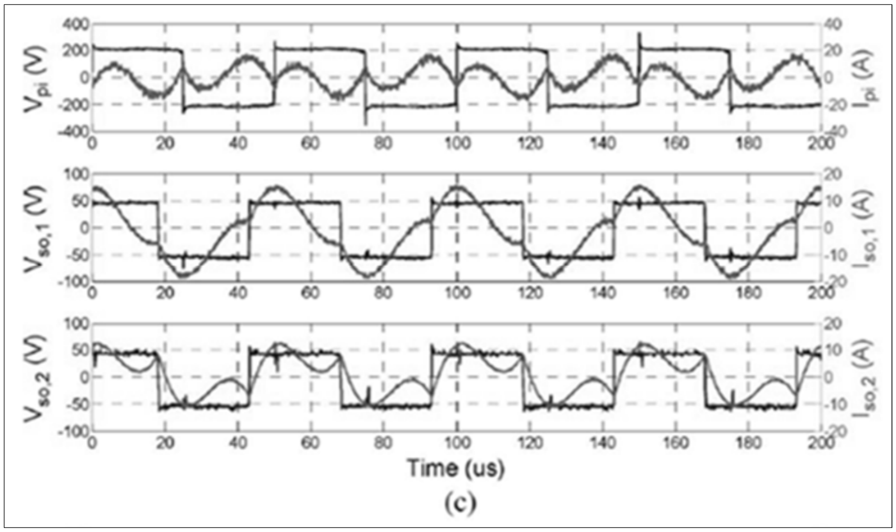


(Ex. PA-11, FIG. 3 (annotated) (illustrating various switching circuits of the *Madawala* power system).)

Madawala discloses a constant 50% duty cycle of the power train used to charge and discharge the wireless battery system in its Figures 9, 10, and 11. (*Id.*, FIGs. 9, 10, 11.) In Figure 9, the pick-up circuit 1 (of Figure 3) receives power from the primary controller. (*Id.*, 4794.) In Figure 10, pickups 1 and 2 deliver power to the primary. (*Id.*) And in Figure 11, pickups 1 and 2 receive power from the primary. (*Id.*, 4795.) Each of the square waveforms shown in the figures has a duty cycle of approximately 50%. Figures 9 and 10 are excerpted below.



(*Id.*, FIG. 9 (illustrating power train voltages V_{pi}, $V_{so,1}$, or $V_{so,2}$ (the square waves) used in a charge mode at 50% duty cycles); *id.*, 4794 ("Fig. 9 shows the comparison between the simulated and measured waveforms in a situation where the primary delivers approximately 600 W to pickup 1 while pickup 2 idles. The top two plots in Fig. 9 are the simulated results, and the bottom two plots show the measured waveforms.").)



(*Id.*, FIG. 10 (illustrating power train voltages V_{pi}, $V_{so,1}$, or $V_{so,2}$ (the square waves) used in a discharge mode at 50% duty cycles); *id.*, 4795 ("Fig. 10 shows the waveforms of the system during the reverse power flow. In this situation, both pickups supply approximately 600 W to the primary. The voltages generated by both pickup-side converters are clearly leading the voltage that is produced by the primary side converter, and hence, the power flow is from the pickup side to the primary.").)

Madawala further discloses that by changing the relative phase relative phase of a voltage of the power train (i.e., without changing a duty cycle), it can reverse the direction of power flow and change between charging and discharging. (*Id.*, 4790 (emphasis added) ("[B]oth amount and **direction of power flow** between EVs or equipment and the grid can be **controlled through** either relative **phase** or/and magnitude **modulation of voltages generated by each converter**."); *id.*, 4792 ("A leading phase angle constitutes power transfer from the pickup to the track or primary, while a lagging phase angle enables power transfer from the track to the pickup. Thus, for any given primary and pickup voltages, both the amount and direction of power flow between the track and the pickup can be regulated by controlling the relative phase angle between voltages generated by primary and pickup reversible rectifiers.") In other words, a POSITA would have understood that *Madawala* discloses using a 50% duty cycle during both charging and discharging, and that the duty cycle does not change between successive charging and discharging. (Ex. PA-DEC, ¶269.)

Madawala is in the same or similar technical field as the ’067 patent and *Jeong*. (Ex. PA-11, Abstract (“Demand for supplying contactless or wireless power for various applications . . . is on the rise. Inductive power transfer (IPT) is a well-recognized technique through which power can be transferred from one system to another with no physical contacts. This paper presents a novel bidirectional IPT system.”); Ex. PAT-A, 1:7-8 (“The present invention is directed, in general, to wireless power transmission.”).) *Madawala* is also reasonably pertinent to problems associated with power converter efficiency, problems with which the inventor was involved. (Ex. PA-11, Abstract (“Results indicate that the proposed system is an ideal power interface for efficient and contactless integration.”); Ex. PAT-A, 1:39 (“[S]tandard wireless power interfaces are inefficient.”); *id.*, 4:37-41 (“The power system as introduced herein . . . preserv[es] the efficiency . . . obtained by [] metallic contact battery power systems.”).) A POSITA considering the problems the inventor was trying to solve would have also looked to *Madawala* because *Madawala* envisions the same type of grid tied wireless power converter discussed in the ’067 patent. (Ex. PAT-A, 10:8-19 (“It is thus possible to use the power system of FIG. 2 in applications that allow the battery V401 to be successively charged and discharged without changing a duty cycle of the power trains. Examples of such applications would include using the battery V401 for load leveling of a utility grid or using the battery V401 to provide peak load demands.”); Ex. PA-11, Abstract (“This paper presents a novel bidirectional IPT system, which is particularly suitable for applications such as plug-in electric vehicles (EVs) and vehicle-to-grid (V2G) systems, where two-way power transfer is advantageous.”).)

In view of the above disclosure of *Madawala*, it would have been obvious, and POSITA would have been motivated, to configure *Jeong*’s bi-directional power transfer system to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit. Given that *Jeong* discloses a power train that charges and discharges a battery, and that *Madawala* discloses an applicable and beneficial technique for controlling power transfer magnitude and direction without changing a duty cycle, it would have been obvious to have the *Jeong* power train be configured to enable the battery to be successively charged and discharged without changing a duty cycle of the switching circuits like *Madawala* discloses. For example, a POSITA would have been motivated to modify *Jeong* as described to simplify the control requirements of the *Jeong* system. (Ex. PA-11, 4790 (explaining how the wireless power system is "simple in design, implementation, and control").) Further, a POSITA would have been motivated to modify *Jang* as described in order to expand its applications to accommodate high-power wireless devices. (*Id.*, ("[I]t allows for modular operation to cater for high-power applications.").) Additionally, a POSITA would look to different applications of wirelessly transferring power across devices with batteries, including for battery electric vehicles like in *Madawala*, because the principle and components required for wirelessly transferring power are the same regardless of what type of device contains a battery—such as whether it is a portable device like a mobile phone or a vehicle.

Further, a POSITA would have had a reasonable expectation of success with the modification. *Madawala* discloses no more than an improved control technique to operate the existing power converter switching circuits, like those disclosed by *Jeong*. Moreover, the proposed modification would have combined known technologies (e.g., known wireless power circuits) according to known methods (e.g., using phase changes to successively discharge and charge a battery without changing a duty cycle) to yield the predictable result of a power train that can successively charge and discharge the battery without changing a duty cycle of the switching circuits. (Ex. PA-DEC, ¶272.) *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

2. Claim 17

a. The system as recited in claim 16 wherein said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with a second duty cycle, said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle.

Jeong in view of *Chao* and *Madawala* discloses or suggests the limitations of claim 17. (Ex. PA-DEC, ¶¶273-276.) As discussed above, *Jeong* in view of *Chao* teaches the elements of claim 7. (*Supra* Section VII.K.4.) And as discussed above for claim element 15[b], *Jeong* discloses a system configured to enable a battery to be charged and discharged through a transformer. (*Supra* Section VII.K.5.b.)

While *Jeong* does not explicitly disclose that "said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with a second duty cycle, said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle," it would have been obvious to a POSITA to modify *Jeong* to implement such features in view of *Madawala*. (Ex. PA-DEC, ¶¶274.)

Madawala generally discloses the features of claim 17 for the reasons discussed above for claim 12. (*See supra* Section VII.O.1.) As discussed above, *Madawala* discloses switching circuits configured to be operated at a 50% duty cycle ("said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with said second duty cycle"), and to enable bi-directional power flow by varying the phase instead of changing the duty cycle ("enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle"). (*Id.*)

A POSITA would have found it obvious, and been motivated, to modify the system of claim 16 in view of *Madawala* for the same reasons discussed above for claim 12. (*Id.*; Ex. PA-DEC, ¶276) Likewise, a POSITA would have had a reasonable expectation of success with the modification for the same reasons. (*See supra* Section VII.O.1; Ex. PA-DEC, ¶276.)

P. SNQ16: *Jeong* in view of *Soar* Renders Obvious Claims 1, 7, 9, 15 and 16

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Soar* discloses or suggests the limitations of claims 1, 7, 9, 15 and 16 of the '067 patent. (Ex. PA-DEC, ¶¶277-299.)

1. Claim 1

a. An apparatus, comprising: a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer; and a battery metallically coupled to said first metallic coil and configured to be charged and discharged through an electrically isolating path of said transformer.

Jeong in view of *Soar* discloses or suggests these claim limitations. As discussed above for claim element 1[a], *see supra* Section VII.K.3.a, *Jeong* discloses or suggests each limitation of claim 1, but does not explicitly disclose "a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer." *Soar* does and it would have been obvious to a POSITA to modify *Jeong* to include these limitations in view of the teachings of *Soar*.

Soar relates to "an inductive wireless charging system that utilizes two separable power ferrite core halves (FIGS. 1A-1F) that form an inductive air core transformer." (Ex. PA-13, 7:44-46.) Specifically, *Soar* discloses with reference to Figures 1A-1F, various configurations of ferrite core halves and inductive coil windings. (*Id.*, 17:20-49.)

Taking Figure 1B as an example, "FIG. 1B [depicts] a pair of E or ETD-cores." (*Id.*, 17:22-26.) "Regardless of the ferrite profile" selected from Figures 1A-1F, however, the transformer is comprised of a "primary ferrite core 1" ("first magnetic core piecepart") with a "primary inductive coil winding 2," shown wound around a portion of ferrite core 1 ("a first metallic coil encircling at least a portion thereof"), and a "secondary ferrite core 3" ("second magnetic core piecepart"), "with a secondary inductive coil winding 4," shown wound around a portion of ferrite core 3 ("second metallic coil encircling at least a portion thereof"). (*Id.*, 17:26-29, FIG. 1B.)

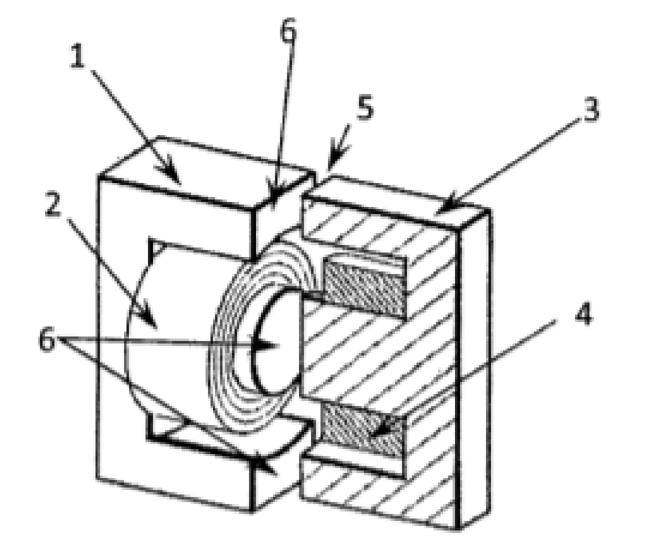


Figure 1B

(*Id.*, FIG. 1B.)

The "inductive charging transformer[s]" disclosed by *Soar* "utilize[] closely coupled ferrite cores that inherently reduce stray magnetic field to low levels." (*Id.*, 2:63-65, 13:36-38 ("Many core or magnetic path materials can be used, such as powdered ferrite, soft iron, laminated steel, silicon-aluminum-iron (Kool-Mu™)."); Ex. PAT-A, 5:25-29 (disclosing that a magnetic core piecepart is "typically composed of . . . a soft ferrite, powered iron, or some other ferromagnetic substance with high magnetic permeability").)

These cores, when positioned together as shown, are configured to couple flux across a transformer and cause flux paths to form through the primary and secondary windings as shown in Figure 3B. (Ex. PA-13, 18:17-39 ("FIGS. 3A and 3B present two different transformer core configurations showing the magnetic flux lines 36 for a primary 31 and secondary 33 E-Core ferrites and their respective coil windings 32,34. . . . The E-core profiles shown are schematically representative of all ferrite core types and profiles.").)

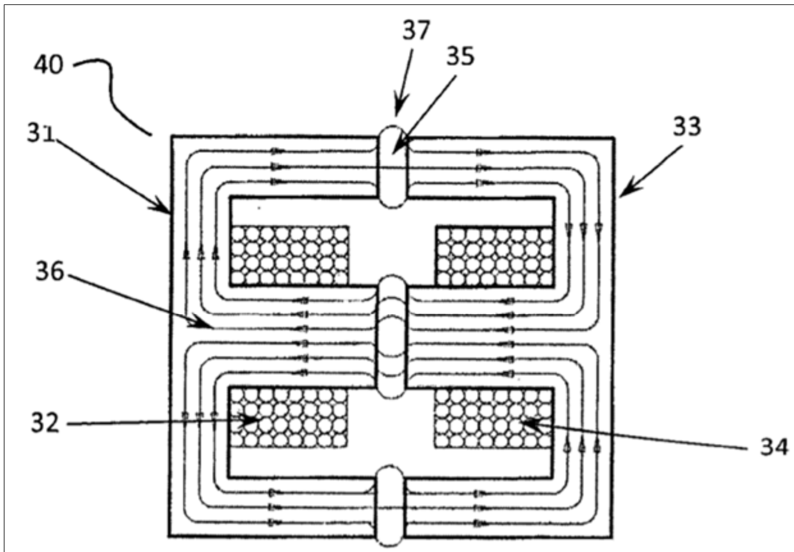


Figure 3B

(*Id.*, FIG. 3B (illustrating a cross-sectional image of the wires of metallic coils 32 and 34); *see also id.*, 18:2-39 ("FIG. 3B shows a pair of E-cores forming an air-core transformer 40 with a small air gap 35 of between 1-4 mm between the three ferrite pole faces as may be used in the wireless inductive dongle power transfer system. When the magnetic flux produced by an energized primary coil bridges the air gap 35, it produces a small amount of stray magnetic flux 37, however substantially all of the magnetic flux is inductively transferred between the cores. For the same level of power transfer, minimal stray magnetic field is emitted from air gap versus large planar coils. The E-core profiles shown are schematically representative of all ferrite core types and profiles.")

A POSITA would have understood that the coils comprise metallic wires that can conduct power and data with low resistance. (*Id.*, 6:6-7 ("In a preferred embodiment the coils have a low direct current resistance."); Ex. PA-DEC, ¶283.)

Soar also discloses that the first magnetic core piecepart and corresponding coil is "configured to be coupled to, aligned with and removable from" the second magnetic core piecepart and corresponding coil. (Ex. PA-DEC, ¶284.) For example, "[t]he first and second coils are configured to be aligned for the inductive coupling when the dongle and the mounting component are mated so as to provide a substantially closed magnetic path between the first and second coils for at least transfer of power between the first and second coils." (Ex. PA-13, 5:40-45; *see also* Abstract ("coils are positioned . . . so that they are aligned for their inductive coupling when the dongle and mounting component are mated," and the "positioning and alignment of the coils provides a substantially closed magnetic path between the coils").) Figure 1B and 3B (above) illustrate how the ferrite cores are aligned and coupled together to form a transformer. (*Id.*, FIGs. 1B, 3B.) Further, the cores and coils are removable from each other to facilitate the portable wireless system. (*Id.*, 15:42-45 ("The primary power receptacle can be placed at any angle that facilitates the insertion and removal of the dongle without causing any untoward strain on either the dongle cable or the soldier."); *id.*, 18:40-46 ("FIG. 4A shows one embodiment in which the primary inductive housing 51 receives the secondary dongle 56 in male/female mating engagement is inserted to obtain wireless inductive power transfer without the use of electrical contacts.").)

In view of the above disclosure of *Soar*, it would have been obvious and a POSITA would have been motivated to use a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer in *Jeong*. As *Soar* explains, such an arrangement provides the benefit of enhanced coil coupling and low stray or residual magnetic flux. (*Id.*, 12:13-18.) Indeed, utilizing the symmetrical combination of ferrite cores and coils described by *Soar* would have increased the power efficiency of the *Jeong* bidirectional power system. (*Id.*, 17:33-42 ("When the primary coil is energized with an alternating current, a magnetic field is produced such that magnetic flux is emitted from the ferrite core pole faces 6 allowing magnetic or inductive coupling to a secondary ferrite core and winding. Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core."); Ex. PA-DEC, ¶285.) Additionally, the proposed configuration would have reduced the electromagnetic interference noise generated in the wireless power system. (Ex. PA-13, 12:64-67 ("A benefit of a pot core ferrite structures is that the outer shell more completely encases the primary and secondary winding and for the most part reduces eliminates any radiated energy such as EMI or stray magnetic flux.").)

A POSITA would have looked to *Soar* because it is in the same or similar technical field as *Jeong*, as both relate to principles and components requires for wirelessly transferring power, which are the same regardless of what type of device power is being transferred to. (Ex. PA-13, 2:45-46 ("The invention described herein [is] an inductive wireless power transfer system.").) *Soar* is also pertinent to problems associated with power transfer efficiency, which would be applicable to *Jeong*'s power converter. (Ex. PA-13, 2:63-65 ("The inductive charging transformer circuit utilises closely coupled ferrite cores that inherently reduce stray magnetic field to low levels."); *id.*,7:67-8:3 ("The substantially closed magnetic path formed between the primary and secondary coil and core assemblies provides for the efficient transmission of power."); *id.*, 17:37-42 ("Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core.")

A POSITA having looked to *Soar* would have had a reasonable expectation of success in modifying *Jeong* in view of *Soar*, as the proposed modification would have combined known technologies (e.g., known wireless power magnetic core and coil configurations) according to known methods (e.g., using wireless power cores with surrounding coils to transmit power) to yield the predictable result of a wireless power apparatus wherein the coils partially encircle magnetic core pieceparts. (Ex. PA-13, FIGs. 1-2B, 5:62-66; Ex. PA-DEC, ¶286.) See *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

The analysis for the remaining limitations of claim 1 is the same as presented for claim 1 in SNQ 11. (*See supra* Section VII.K.3.) Further, *Jeong* in view of *Soar* discloses or suggests the "magnetic core piecepart" under the District Court's construction, *see supra* Section V, where the "magnetic core piecepart" is a "core piece that is made of magnetic material," because as described above, a POSITA would have found it obvious to increase the power efficiency of the *Jeong* bidirectional power system by implementing an arrangement similar to that described in *Soar*, which utilizes two separable power ferrite core halves (i.e., core pieces made of magnetic material). Likewise, *Jeong* in view of *Soar* discloses or suggests the "magnetic core piecepart" under the Board's construction, *see supra* Section V, where the "magnetic core piecepart" is "a magnetic part that cooperates with at least one other magnetic part to create a flux path that passes through the first and second metallic coils." As described above, a POSITA would have been motivated to improve the *Jeong* bidirectional power system by implementing an arrangement similar to that described in *Soar*, which utilizes two separable power ferrite core halves (two magnetic parts), each with inductive coil windings, which when positioned together cause flux paths to form through the coil windings. (Ex. PA-DEC, ¶287.)

2. Claim 7

a. The apparatus as recited in claim 1 further comprising a power train including a first switching circuit coupled to said first metallic coil configured to form a portion of a resonant topology with a second switching circuit coupled to said second metallic coil.

Jeong and *Soar* disclose or suggest the limitations of claim 7 for the same reasons presented above for claims 1 and 7. (*See supra* Sections VII.K.3, 4; Ex. PA-DEC, ¶288.) That *Jeong* is combined with *Soar* instead of *Chao* does not change the applicability of the analysis to the *Jeong* apparatus discussed in SNQ 11. (Ex. PA-DEC, ¶288.)

3. Claim 15

a. A system, comprising: a wireless battery interface including a wireless battery interface magnetic core piecepart; and a wireless battery, including: a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer; and a battery metallically coupled to a first metallic coil encircling at least a portion of said wireless battery magnetic core piecepart and configured to be charged and discharged through an electrically isolating path of said transformer.

Jeong in view of *Soar* discloses or suggests these claim limitations. (Ex. PA-DEC, ¶¶289-298.) As discussed above for claim 15, *see supra* Section VII.K.5, *Jeong* discloses or suggests each limitation of claim 15, but does not explicitly disclose "a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer." *Soar* does and it would have been obvious to a POSITA to modify *Jeong* to include these limitations in view of the teachings of *Soar*. (Ex. PA-DEC, ¶289.)

Soar relates to "an inductive wireless charging system that utilizes two separable power ferrite core halves (FIGS. 1A-1F) that form an inductive air core transformer." (Ex. PA-13, 7:44-46.) Specifically, *Soar* discloses with reference to Figures 1A-1F, various configurations of ferrite core halves and inductive coil windings. (*Id.*, 17:20-49.)

Taking Figure 1B as an example, "FIG. 1B [depicts] a pair of E or ETD-cores." (*Id.*, 17:22-26.) "Regardless of the ferrite profile" selected from Figures 1A-1F, however, the transformer is comprised of a "primary ferrite core 1" ("wireless battery magnetic core piecepart") with a "primary inductive coil winding 2", shown wound around a portion of ferrite core 1 ("a first metallic coil encircling ate least a portion of said wireless battery magnetic core piecepart""), and a "secondary ferrite core 3" ("wireless battery interface magnetic core piecepart"), "with a secondary inductive coil winding 4," shown wound around a portion of ferrite core 3. (*Id.*, 17:26-29, FIG. 1B.)

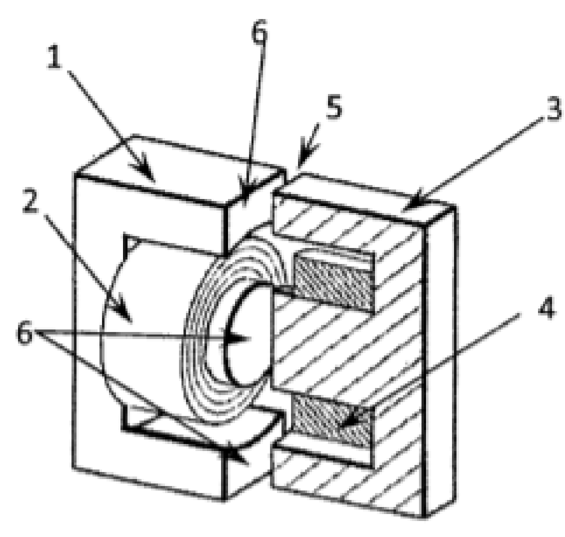


Figure 1B

(*Id.*, FIG. 1B.)

The "inductive charging transformer[s]" disclosed by *Soar* "utilize[] closely coupled ferrite cores that inherently reduce stray magnetic field to low levels." (*Id.*, 2:63-65, 13:36-38 ("Many core or magnetic path materials can be used, such as powdered ferrite, soft iron, laminated steel, silicon-aluminum-iron (Kool-Mu™)."); Ex. PAT-A, 5:25-29 (disclosing that a magnetic core piecepart is "typically composed of . . . a soft ferrite, powered iron, or some other ferromagnetic substance with high magnetic permeability").)

These cores, when positioned together as shown, are configured to couple flux across a transformer and cause flux paths to form through the primary and secondary windings as shown in Figure 3B. (Ex. PA-13, 18:17-39 ("FIGS. 3A and 3B present two different transformer core configurations showing the magnetic flux lines 36 for a primary 31 and secondary 33 E-Core ferrites and their respective coil windings 32,34. . . . The E-core profiles shown are schematically representative of all ferrite core types and profiles.").)

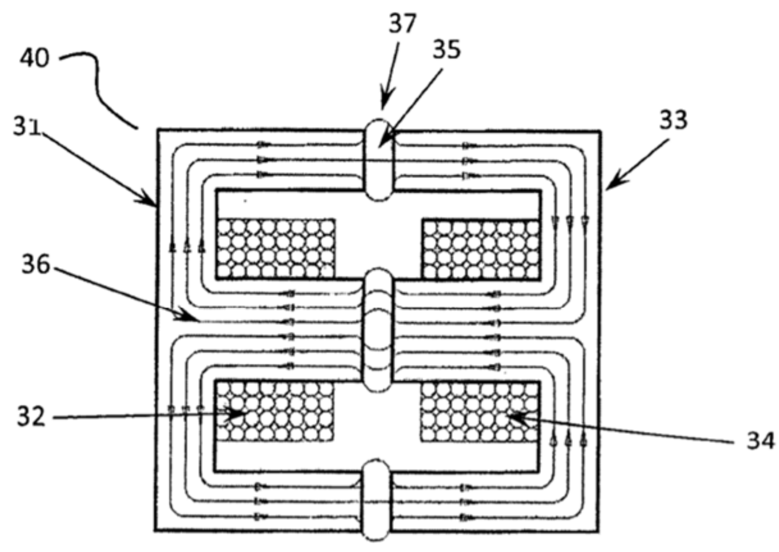


Figure 3B

(*Id.*, FIG. 3B (illustrating a cross-sectional image of the wires of metallic coils 32 and 34); *see also id.* 18:2-39 ("FIG. 3B shows a pair of E-cores forming an air-core transformer 40 with a small air gap 35 of between 1-4 mm between the three ferrite pole faces as may be used in the wireless inductive dongle power transfer system. When the magnetic flux produced by an energized primary coil bridges the air gap 35, it produces a small amount of stray magnetic flux 37, however substantially all of the magnetic flux is inductively transferred between the cores. For the same level of power transfer, minimal stray magnetic field is emitted from air gap versus large planar coils. The E-core profiles shown are schematically representative of all ferrite core types and profiles.")

A POSITA would have understood that the coils comprise metallic wires that can conduct power and data with low resistance. (*Id.*, 6:6-7 ("In a preferred embodiment the coils have a low direct current resistance."); Ex. PA-DEC, ¶294.)

Soar also discloses that the wireless battery magnetic core piecepart and corresponding coil is "configured to be coupled to, aligned with and removable from" the wireless battery interface magnetic core piecepart. (Ex. PA-DEC, ¶295.) For example, "[t]he first and second coils are configured to be aligned for the inductive coupling when the dongle and the mounting component are mated so as to provide a substantially closed magnetic path between the first and second coils for at least transfer of power between the first and second coils." (Ex. PA-13, 5:40-45; *see also* Abstract ("coils are positioned . . . so that they are aligned for their inductive coupling when the dongle and mounting component are mated," and the "positioning and alignment of the coils provides a substantially closed magnetic path between the coils").) Figure 1B and 3B (above) illustrate how the ferrite cores are aligned and coupled together to form a transformer. (*Id.*, FIGs. 1B, 3B.) Further, the cores and coils are removable from each other to facilitate the portable wireless system. (*Id.*, 15:42-45 ("The primary power receptacle can be placed at any angle that facilitates the insertion and removal of the dongle without causing any untoward strain on either the dongle cable or the soldier."); *id.*, 18:40-45 ("FIG. 4A shows one embodiment in which the primary inductive housing 51 receives the secondary dongle 56 in male/female mating engagement is inserted to obtain wireless inductive power transfer without the use of electrical contacts.").)

In view of the above disclosure of *Soar*, it would have been obvious and a POSITA would have been motivated to use a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer in *Jeong*. (Ex. PA-DEC, ¶295.) As *Soar* explains, such an arrangement provides the benefit of enhanced coil coupling and low stray or residual magnetic flux. (Ex. PA-13, 12:13-18.) Indeed, utilizing the symmetrical combination of ferrite cores and coils described by *Soar* would have increased the power efficiency of the *Jeong* bidirectional power system. (*Id.*, 17:33-42 ("When the primary coil is energized with an alternating current, a magnetic field is produced such that magnetic flux is emitted from the ferrite core pole faces 6 allowing magnetic or inductive coupling to a secondary ferrite core and winding. Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core."); Ex. PA-DEC, ¶296.) Additionally, the proposed configuration would have reduced the electromagnetic interference noise generated in the wireless power system. (Ex. PA-13, 12:64-67 ("A benefit of a pot core ferrite structures is that the outer shell more completely encases the primary and secondary winding and for the most part reduces eliminates any radiated energy such as EMI or stray magnetic flux.").)

A POSITA would have looked to *Soar* because it is in the same or similar technical field as *Jeong*, as both relate to principles and components requires for wirelessly transferring power, which are the same regardless of what type of device power is being transferred to. (*Id.*, 2:45-46 ("The invention described herein [is] an inductive wireless power transfer system."); Ex. PA-DEC, ¶297.) *Soar* is also pertinent to problems associated with power transfer efficiency, which would be applicable to *Soar*'s power converter. (Ex. PA-13., 2:63-65 ("The inductive charging transformer circuit utilises closely coupled ferrite cores that inherently reduce stray magnetic field to low levels."),7:67-8:3 ("The substantially closed magnetic path formed between the primary and secondary coil and core assemblies provides for the efficient transmission of power."), 17:37-42 ("Two coil windings could also be placed adjacent to or within each other without utilizing ferrite cores, however the magnetic coupling and resulting electrical efficiency would be much less as the magnetic field would not be contained within the ferrite core.").)

A POSITA having looked to *Soar* would have had a reasonable expectation of success in modifying *Jeong* in view of *Soar*, as the proposed modification would have combined known technologies (e.g., known wireless power magnetic core and coil configurations) according to known methods (e.g., using wireless power cores with surrounding coils to transmit power) to yield the predictable result of a wireless power apparatus wherein the coils partially encircle magnetic core pieceparts. (*Id.*, FIGs. 1-2B, 5:62-66; Ex. PA-DEC, ¶298.) See *KSR Intern. Co. v. Teleflex Inc*., 550 U.S. 398, 416 (2007).

The analysis for the remaining limitations of claim 15 is the same as presented for claim 15 in SNQ 11. (*See supra* Section VII.K.5.) Further, *Jeong* in view of *Soar* discloses or suggests the "magnetic core piecepart" under both the District Court and Board's constructions for similar reasons as explained for claim 1 in Section VII.P.1. (Ex. PA-DEC, ¶298.)

4. Claim 16

a. The system as recited in claim 15 further comprising a power train including a first switching circuit of said wireless battery configured to form a portion of a resonant topology with a with a second switching circuit of said wireless battery interface.

Jeong and *Soar* disclose or suggest the limitations of claim 16 for the same reasons presented above for claims 7 and 15. (*See supra* Section VII.P.2-3; Ex. PA-DEC, ¶299.)

Q. SNQ17: *Jeong* in view of *Soar* and *Yang* Renders Obvious Claim 8

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Soar* and further in view of *Yang* discloses or suggests the limitations of claim 8 of the ’067 patent. (Ex. PA-DEC, ¶¶300-302.)

1. Claim 8

a. The apparatus as recited in claim 7 further comprising a controller configured to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level.

Jeong in view of *Soar* and *Yang* discloses or suggests the limitations of claim 8 for the reasons discussed (*supra* Section VII.B) in SNQ 2 (*Jang* in view of *Brockmann* and *Yang*). (Ex. PA-DEC, ¶¶301-302.) The analysis of *Yang* in SNQ 2 is applicable here given that *Jang* and *Jeong* both teach full bridge circuits. (*Id.*, ¶302.) Thus, given the bridge circuit of the *Jeong*-*Soar* power train, a POSITA would have been motivated to selectively cause at least a portion of said power train to switch between full-bridge and half-bridge operation in response to a sensed voltage level, as suggested by *Yang*, for the reasons discussed. (*Id.*)

R. SNQ18: *Jeong* in view of *Soar* and *Kardolus* Renders Obvious Claim 9

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Soar* and further in view of *Kardolus* discloses or suggests the limitations of claim 9 of the ’067 patent. (Ex. PA-DEC, ¶¶303-304.)

1. **Claim 9**

   a. **The apparatus as recited in claim 7 wherein said power train is configured to be intermittently operated in a burst mode of operation to control a characteristic of said battery.**

Jeong in view of *Soar* and *Kardolus* discloses or suggests the limitations of claim 9 for the reasons discussed (*supra* Section VII.M) in SNQ 13. (Ex. PA-DEC, ¶304.) The analysis of *Kardolus* in SNQ 13 is applicable here to the modified *Jeong-Soar* combination. Thus a POSITA would have been motivated to select a capacitor to produce zero-current switching of a first switching circuit in conjunction with an inductor, as suggested by *Kardolus*, for the reasons discussed. (Ex. PA-DEC, ¶304.) Moreover, *Jeong* in view of *Soar* and *Kardolus* discloses or suggests the "burst mode of operation" as construed by the District Court, *see supra* Section V, to mean "a mode of operation wherein the power train is periodically activated and deactivated" because as described above, a POSITA would have found it obvious to configure *Jeong*'s power train to operate in a burst mode of operation, as taught by *Kardolus*, so that the sequences of on pulses of its switches are separated by breaks, i.e., periodically activated and deactivated. (Ex. PA-DEC, ¶304.)

S. SNQ19: Jeong in view of Soar and Lee Renders Obvious Claims 10 and 11

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Soar* and further in view of *Lee* discloses or suggests the limitations of claims 10 and 11 of the '067 patent. (Ex. PA-DEC, ¶¶305-307.)

1. **Claim 10**

   a. **The apparatus as recited in claim 7 further comprising a capacitor selected to produce substantially zero-current switching of said first switching circuit in said power train in conjunction with an inductor.**

Jeong in view of *Soar* and *Lee* discloses or suggests the limitations of claim 10 for the reasons discussed (*supra* Section VII.N) in SNQ 14. (Ex. PA-DEC, ¶306.) The analysis of *Lee* in SNQ 14 is applicable here to the modified *Jeong-Soar* combination. Thus, given the capacitive and inductive elements of the *Jeong-Soar* power system, a POSITA would have been motivated to select a capacitor to produce zero-current switching of a first switching circuit in a power train in conjunction with an inductor, as suggested by *Lee*, for the reasons discussed. (Ex. PA-DEC, ¶306.)

2. Claim 11

a. The apparatus as recited in claim 10 wherein said inductor is formed at least in part with said first metallic coil.

Jeong in view of *Soar* and *Lee* discloses or suggests the limitations of claim 11 for the reasons discussed *supra* in SNQ 14. (*See supra* Section VII.N; Ex. PA-DEC, ¶307.) That *Jeong* is combined with *Soar* instead of *Chao* does not change the applicability of the analysis to the *Jeong* apparatus discussed in SNQ 14. (Ex. PA-DEC, ¶307.)

T. SNQ20: *Jeong* in view of *Soar* and *Madawala* Renders Obvious Claims 12 and 17

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Jeong* in view of *Soar* and further in view of *Madawala* discloses or suggests the limitations of claims 12 and 17 of the '067 patent. (Ex. PA-DEC, ¶¶308-310.)

1. Claim 12

a. The apparatus as recited in claim 7 wherein said power train is configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit.

Jeong in view of *Soar* and *Madawala* discloses or suggests the limitations of claim 12 for the reasons discussed (*supra* Section VII.O.1) in SNQ 15. (Ex. PA-DEC, ¶309.) That *Jeong* is combined with *Soar* instead of *Chao* does not change the applicability of the analysis to the *Jeong* apparatus discussed in SNQ 15. (Ex. PA-DEC, ¶309.)

2. Claim 17

a. The system as recited in claim 16 wherein said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with a second duty cycle, said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle.

Jeong in view of *Soar* and *Madawala* discloses or suggests the limitations of claim 17 for the reasons discussed (*supra* Section VII.O.2) in SNQ 15. (Ex. PA-DEC, ¶310.) That *Jeong* is combined with *Soar* instead of *Chao* does not change the applicability of the analysis to the *Jeong* system discussed in SNQ 15. (Ex. PA-DEC, ¶310.)

U. SNQ21: *Anguelov* in view of *Jang* Renders Obvious Claims 1, 7, 10-12, and 15-17

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), *Anguelov* in view of *Jang* discloses or suggests the limitations of claims 1, 7, 10-12 and 15-17 of the '067 patent. (Ex. PA-DEC, ¶¶311-362.)

1. Overview of *Anguelov*

Anguelov relates to a "bi-directional DC to DC resonant converter." (Ex. PA-5, 1:66-2:8.) With reference to Figure 1, Anguelov describes an exemplary embodiment. (*Id.*, 5:66-6:8.) In the converter of Figure 1, the left side of the converter is configured to transfer power to the right side through the "magnetic structure of transformer 18," and vice-versa. (*Id.*, 6:6-67.) Transformer 18 includes winding 17 on the left side and windings 19 and 20 on the right side, which are connected in series and center-tapped. (*Id.*, 6:27-44.) Power can be transferred from DC power source 1 on the left to impedance 26 on the right, or power can flow from the right to left, in which case load impedance 26 acts as a source and DC power source 1 acts as a load. (*Id.*, 6:8-11, 6:54-68.)

In the case of power transfer from the left side of the transformer to the right, switching devices 4, 5, 6, and 7, on the left side are turned on and off with 50% duty cycle to produce a square-wave voltage waveform with 50%. (*Id.*, 6:19-23.) Switching devices 21 and 22 on the right are likewise controlled in a synchronous rectification manner with approximately 50% duty cycle to rectify the square-wave voltage produced across the transformer. (*Id.*, 6:44-47.) When power is transferred from the right side to the left, the two sets of switching devices reverse their roles but maintain their duty cycles at 50%. (*Id.*, 6:58-67.)

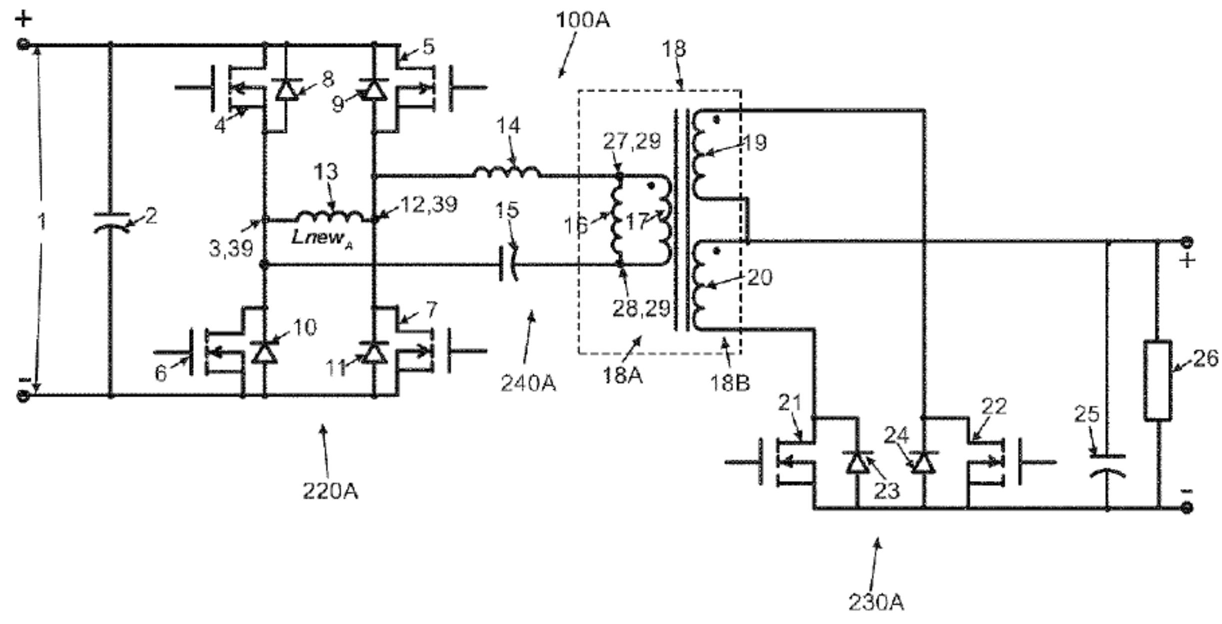


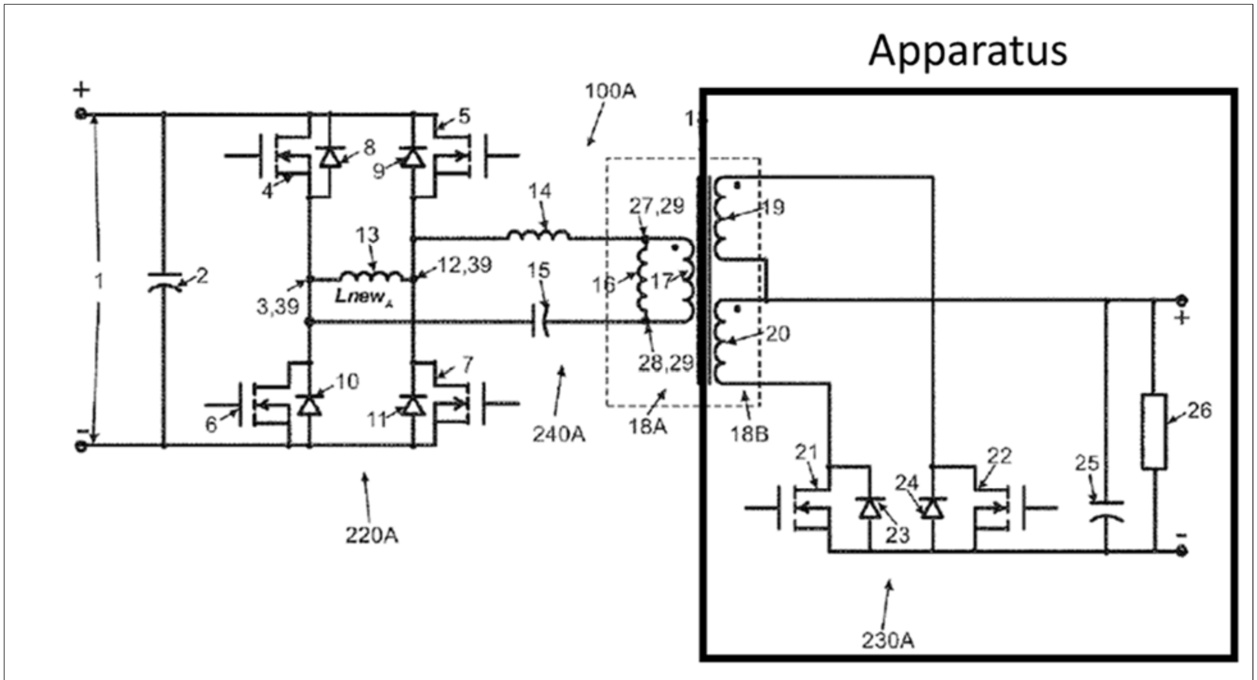
FIG. 1

(Ex. PA-5, FIG. 1.)

2. Claim 1

a. [1.a] An apparatus, comprising:

To the extent the preamble is limiting, *Anguelov* discloses the limitations of claim 2. (Ex. PA-DEC, ¶314.) Specifically, *Anguelov* discloses "[a] resonant, bi-directional, DC to DC voltage converter," such as the "bidirectional converter 100A embodying the principles of the invention [and] shown in FIG. 1." (Ex. PA-5, 6:6-8, FIG. 1.) The converter includes a "left hand side of the circuitry," *i.e.*, the circuitry on the left side of transformer 18 in Figure 1 ("an apparatus"), and a "right hand side of the circuitry," on the right side of transformer 18. (Ex. PA-5, 6:6-11, 6:27-29, 6:54-57, FIG. 1.)



(Ex. PA-5, FIG. 1 (annotated); Ex. PA-DEC, ¶314.)

b. [1.b] a first magnetic core piecepart having a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof to form a transformer; and

Anguelov in view of *Jang* discloses or suggests the limitations of claim 1. (Ex. PA-DEC, ¶¶315-325.) *Anguelov* discloses "primary winding 17 located on the primary side 18A of transformer 18" ("first metallic coil") and "secondary winding[] 19 . . . located on the secondary side 18B of transformer 18" ("second metallic coil"). (Ex. PA-5, 6:27-29, 6:34-43.) *Anguelov* further discloses that transformer 18 has a "magnetic structure." (*Id.*, 6:33 ("magnetic structure of transformer 18").) Transformer 18 is depicted having two vertical lines between the left side 18A and the right side 18B. (Ex. PA-5, FIG. 1.) From these vertical lines and the description of transformer 18 as a transformer having a "magnetic structure" a POSITA would have understood that the transformer coils are wound around an iron core ("first metallic coil encircling at least a portion thereof"; "second metallic coil encircling at least a portion thereof"). (Ex. PA-DEC, ¶315.)

Schaum's Outline of Theory and Problems of Basic Circuit Analysis ("*Schaum*")[3] confirms how a POSITA would have understood *Anguelov*'s disclosure of transformer 18 having a magnetic structure because it describes how a "typical" transformer has windings wound around a magnetic core:

> A *transformer* has two or more windings, also called coils, that are magnetically coupled. As shown in Fig. 16-1, a typical transformer has two windings wound on a core that may be made from iron. Each winding encirclement of the core is called a *turn*, and is designated by *N*. Here, winding 1 has N_1 = 4 turns and winding 2 has N_2 = 3 turns . . . . [W]inding 1 is called the *primary winding* or just *primary,* and winding *2* is called the *secondary winding* or just *secondary.*

(Ex. PA-15, 349; *see also id.* FIG. 16-1.)

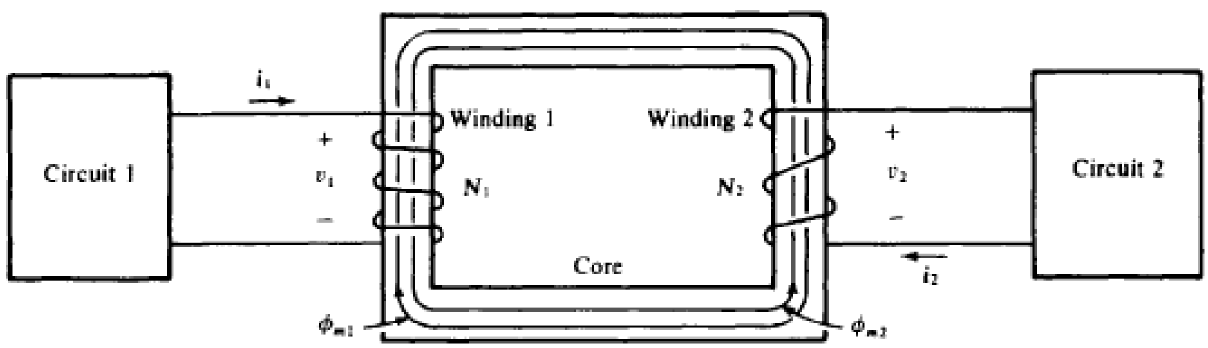


Fig. 16-1

(*Id.*, FIG. 16-1.)

Schaum further explains that a transformer core confines flux to the core so that it passes through or couples the coil winding on the opposite side of the transformer:

> In the operation, current $\boldsymbol{i_1}$ flowing in winding 1 produces a magnetic flux ϕ_{m1} that, for power transformers, is ideally confined to the core and so passes through or couples winding 2. The *m* in the subscript means "mutual"– the flux is *mutual* to both windings. Similarly, current i_2, flowing in winding 2 produces a flux ϕ_{m2} that couples winding 1. When these currents change in magnitude or direction, they produce corresponding changes in the fluxes and these changing fluxes induce voltages in the windings. In this way, the

[3] *Schaum* is referred to herein solely to show how a POSITA would have understood *Anguelov*'s disclosures.

> transformer couples circuit 1 and circuit 2 so that electric energy can flow from one circuit to the other.

(Ex. PA-15, 349; *see also id.*, FIG. 16-1.)

Schaum also explains that a schematic of an inductor having two vertical lines between the inductor symbols (like *Anguelov*'s transformer 18), represents an iron-core transformer: "In Fig. 16-31, the two vertical lines between the inductor symbols designate the transformer as either **an iron-core transformer** or an ideal transformer." (Ex. PA-15, 349 (emphasis added), *see also id.*, FIG. 16-3.)

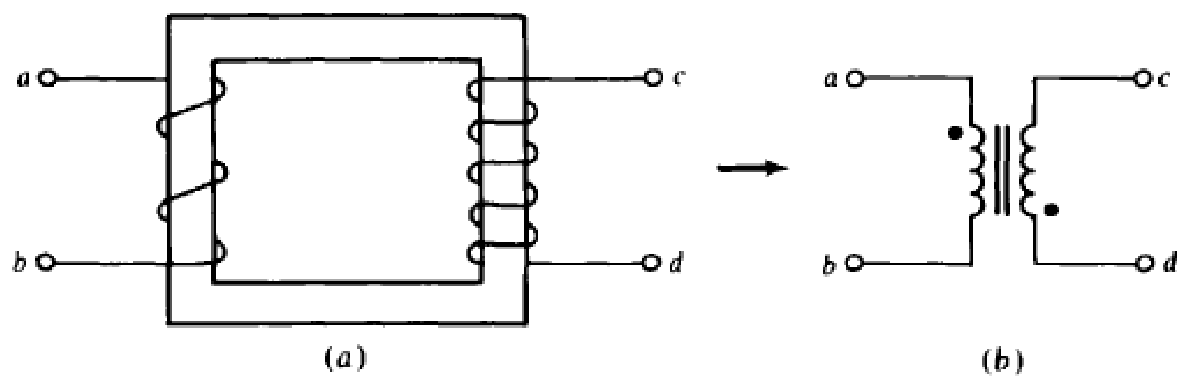


Fig. 16-3

(*Id.*, FIG. 16-3.)

Consistent with *Schaum*'s explanation of transformer terminology, including that transformers are formed from inductors having windings around an iron core and that an iron-core transformer is represented in a circuit diagram with two vertical lines, as in *Anguelov*'s Figure 1, a POSITA would have understood from *Anguelov*'s disclosure that its transformer windings were wound around cores ("encircling at least a portion thereof"). (Ex. PA-DEC, ¶319.)

Although *Anguelov* discloses a first metallic coil and a second metallic coil each encircling a magnetic core piecepart, *Anguelov* does not disclose that the coils encircle different magnetic core pieceparts where a first magnetic core piecepart is configured to be coupled to, aligned with, and removable from a second magnetic core piecepart. However, in view of *Jang*, it would have been obvious, and a POSTIA would have been motivated, to incorporate these features into *Anguelov*. (Ex. PA-DEC, ¶320.)

Jang discloses in an analogous power converter, a transformer T having two inductors, and describes in an exemplary embodiment that such a transformer in a power converter can be "built using ferrite cores (2624Z)." (Ex. PA-1, 7:14-24.) Moreover, *Jang*'s power converter is wireless (what *Jang* calls "contactless electrical energy transmission" or "CEET"), and in such a system a POSITA would have understood that a transformer should be made from two halves, otherwise the apparatus that is being wirelessly charged or discharged would be fixed to the other apparatus, generally defeating the benefits of wireless charging. (Ex. PA-DEC, ¶321.) Thus, a POSITA implementing *Anguelov*'s apparatus in a wireless fashion like *Jang*'s would have been motivated to have the first metallic coil (*Anguelov*'s winding 17) and second metallic coil (*Anguelov*'s winding 19) wound around ("encircling at least a portion") of a first magnetic core piecepart and a second magnetic core piecepart, to facilitate the wireless power transfer functionality disclosed by *Jang* and discussed in more detail in Sections VII.A.1, and VII.A.3.b. (*See supra* Section VII.A.1, VII.A.3.b; Ex. PA-DEC, ¶321.) For the reasons discussed in Section VII.A.3.b, *Jang* further discloses that the cores implemented in an apparatus configured for wireless power such as the *Anguelov*'s apparatus, as modified by *Jang*, would be configured to be coupled to, aligned with, and removable from one another. (*Supra* Section VII.A.3.b.) This type of transformer configuration, with separate core pieces, each having a coil winding around them, was well-known in the art. (*See e.g.*, Ex. PA-7, 2, FIG. 1 (illustrating an example of primary and secondary "winding[s]" of a wireless transformer, wherein the windings wrap around magnetic structures of the transformer); Ex. PA-13, 12:31-59, FIGs. 1A-C (same); Ex. PA-14, 1:22-32 ("Inductive chargers have . . . been proposed in a number of documents such as U.S. Pat. No. 6,356,049, U.S. Pat. No. 6,301,128, U.S. Pat. No. 6,118,249. These inductive chargers . . . use traditional transformer designs with windings wound around ferrite magnetic cores."); Ex. PA-DEC, ¶¶321.)

Anguelov's core, as modified in view of *Jang* to be two iron cores, would also satisfy the constructions for "magnetic core piecepart" for the reasons discussed above in this section (confining flux so that flux paths from one core pass through the other core and through both coils), and for those reasons discussed in Section VII.A.3.b with respect to *Jang*. (*Supra* Section VII.A.3.b; Ex. PA-DEC, ¶322.)

A POSITA would have been motivated, and would have found it obvious, to configure *Anguelov*'s power converter for wireless power transfer with the modifications discussed above from *Jang*. (Ex. PA-DEC, ¶323.) For example, a POSITA would have found motivation in *Jang*'s disclosure of the benefits of wireless power transfer:

> In many applications, the contactless electrical energy transmission (CEET) has distinct advantages over the conventional energy transmission system which uses wires and connectors. For example, the CEET has been the preferred power-delivery approach in hazardous applications such as mining and underwater environments due to the elimination of the sparking and the risk of electrical shocks [1]. Also, a number of CEET systems have been developed for electric vehicle battery-recharging applications because of their potential enhanced safety, reliability, and convenience. In addition, the CEET has been considered in medical applications since it makes possible to transfer electric energy, which is required for running implanted electrical circulatory assist devices, through the intact skin of a patient [2]. Finally, the CEET has been used in cordless electric tooth brushes and portable telephones to increase their reliability by eliminating the contacts between their battery charger and the battery.

(Ex. PA-1, 1:11-29.)

A POSITA would have recognized that *Anguelov*'s apparatus, in a similar power converter field to *Jang*, could similarly provide these benefits if it were modified so that the two halves of its transformer cores were able to be removed from one another so that it was configured to be used for wireless power transfer like *Jang*. (Ex. PA-DEC, ¶324.) *First*, like *Anguelov*, *Jang* discloses bidirectional power flow between a source and a load, where power is transferred from one side to the other through a transformer. *Second*, *Jang* discloses that "any resonant topology can be employed" and thus a POSTIA would have expected that the resonant topology of *Anguelov*'s Figure 1 apparatus could be employed in a contactless or wireless power transfer application like *Jang* discloses. (*See e.g.*, Ex. PA-5 7:36-38 ("Referring back to FIG. 1, the network of inductors 13, 14, 16 and capacitor 15 are employed in resonant network circuit 240A.") *Third*, *Anguelov*'s Figure 1 circuit, like *Jang*'s Figure 10 circuit, discussed above (*see generally supra* Section VII.A) is configured with a full-bridge switching circuit on one side and a half-bridge switching circuit on the other. Given the similarity between the disclosures, and the advantages *Jang* teaches about contactless energy transfer in wireless applications, a POSITA would have been motivated, and found it obvious, to modify *Anguelov*'s power converter to have "a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof." (Ex. PA-DEC, ¶324.)

For the reasons discussed above (*e.g.*, similarity of the *Anguelov* and *Jang* circuitry and function, and *Jang*'s disclosure that any resonant topology could be employed), a POSITA would have had a reasonable expectation of success in the combination. Such a combination would have been combining a known technique (wireless power transfer using separate cores for each coil as taught by *Jang*) to improve a similar device (*Anguelov*'s bi-directional power converter having one transformer core) in the same way (*e.g.*, a modification to make *Anguelov*'s apparatus wireless). (Ex. PA-DEC, ¶325.) Such a modification would have been well within a POSITA's skill, as would any other modifications necessary to implement the combination. (*Id.*)

c. [1.c] a battery metallically coupled to said first metallic coil and configured to be charged and discharged through an electrically isolating path of said transformer.

Anguelov in view of *Jang* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶326-329.) Specifically, *Anguelov* discloses "DC voltage source 1" ("a battery") having a positive terminal and a negative terminal connected through full-bridge switcher circuit 220A to inductor 17 ("metallically coupled to said first metallic coil") (Ex. PA-5, 6: 6-33, FIG. 1; *see also* Ex. PAT-A, 6:48-55 (broadly defining "metallic" connections). The bi-directional converter 100A (the entire system of Figure 1) can "transfer [power] from the left hand side to the right hand side of the circuitry" (i.e., from "DC voltage source 1" on the left side of the transformer 18 to "load impedance 26" on the right side of transformer 18) or "from the right hand side to [the] left hand side of the circuitry in FIG. 1" ("configured to be charged and discharged"). (Ex. PA-5, 6:8-11, 6:54-58.) In the latter case, "the power source and the load exchange their places, i.e. load impedance 26 becomes a DC voltage source, while DC voltage source 1 becomes a load." (Ex. PA-5, 6:54-58.) As disclosed by *Anguelov* in Figure 1, transformer 18 is the only path connecting DC voltage source 1 on the left hand side of transformer 18 with load impedance 26 on the right hand side of transformer 18 in Angualov's bi-directional converter, and thus there is no wired connection between the right hand circuitry and the left hand circuitry through which electricity could flow ("an electrically isolating path of said transformer").

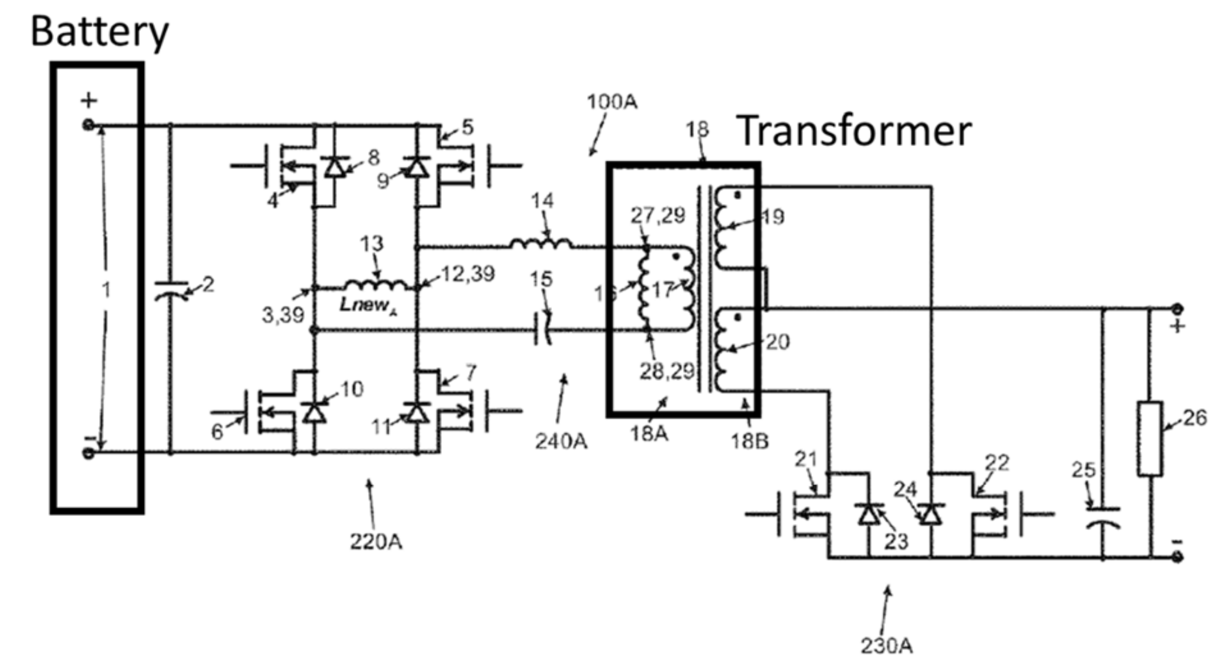


FIG. 1

(Ex. PA-5, FIG. 1 (annotated).)

Anguelov's Figures 8 and 9 schematically illustrate "simplified versions of FIG. 1 during power conversion in both directions of power transfer through bi-directional converter 100A." (Ex. PA-5, 7:48-54; *see also id.*, 7:54-11:19 (describing FIGs. 8 and 9.) In Figure 8, arrow 222 indicates "power transfer from the left hand side to the right hand side" and in Figure 9, arrow 224 indicates "power transfer from the right hand side to the left hand side." (*Id.*, 7:54-59.)

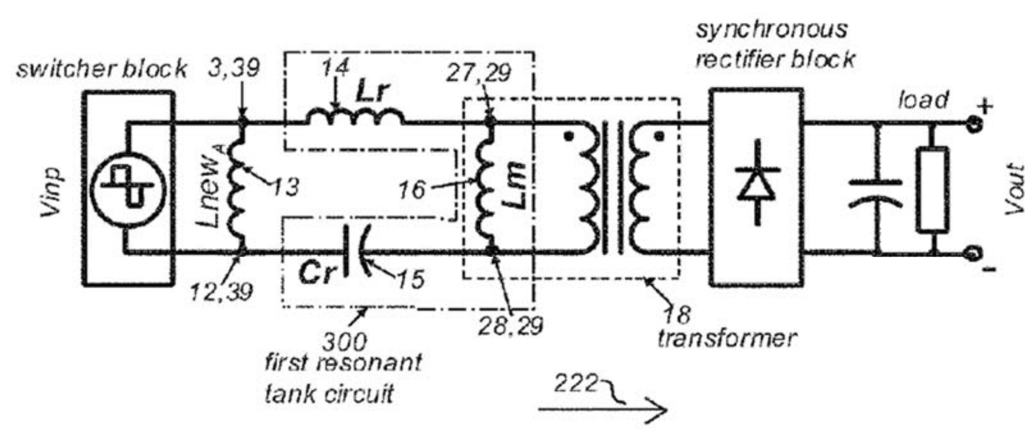


FIG. 8

(*Id.*, FIG. 8.)

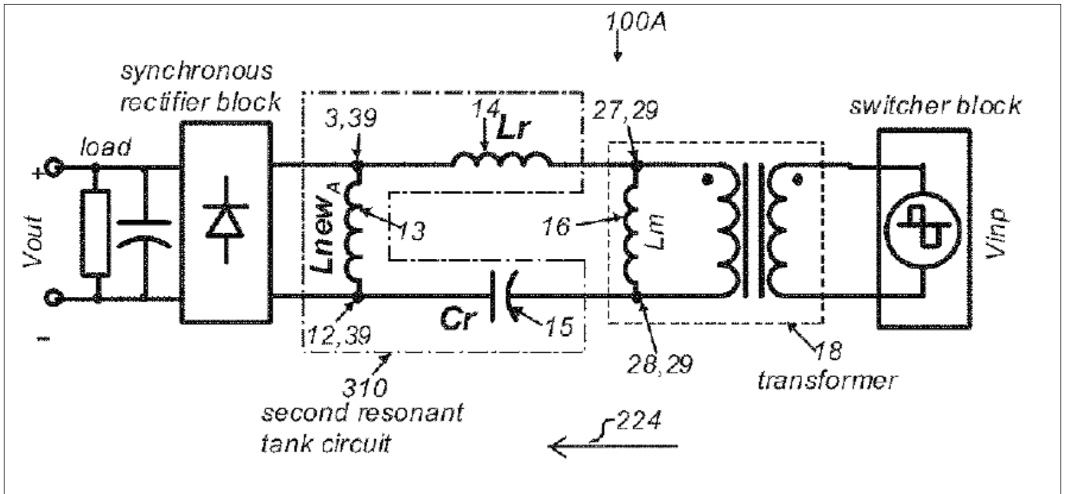


FIG. 9

(*Id.*, FIG. 9.)

A POSITA would have understood that "DC voltage source 1," that "becomes a load" when the power flow reverses directions is a battery. (Ex. PA-5, 6:54-58, FIGs. 8, 9; Ex. PA-DEC, ¶328.) This is at least because a circuit component that is capable of being both a source and a load would be readily recognized by a POSITA as a battery. (Ex. PA-DEC, ¶328.) Moreover, *Anguelov* references "a battery connected to [the] terminals" of "bi-directional power converters" (Ex. PA-5, 9:65-67) from which a POSITA would have understood that *Anguelov* contemplates that the terminals of a bi-directional converter, such as those on the right side of Figure 1, could be connected to the positive and negative terminals of a battery, such as load impedance 26. Therefore, *Anguelov* discloses a battery metallically coupled to said first metallic coil (coil 17) and configured to be charged and discharged through an electrically isolating path of said transformer (transformer 18).

The modification of *Anguelov* in view of *Jang* described above in Section VII.U.2.b for claim 1 does not change this analysis. (Ex. PA-DEC, ¶329.)

3. Claim 7

a. The apparatus as recited in claim 1 further comprising a power train including a first switching circuit coupled to said first metallic coil configured to form a portion of a resonant topology with a second switching circuit coupled to said second metallic coil.

Anguelov in view of *Jang* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶330-332.) *Anguelov,* as modified by *Jang* above for claim 1, discloses the limitations of claim 1, including the primary winding 17 ("first metallic coil") and secondary winding 19 ("second metallic coil"). *Anguelov* further discloses circuitry on the left side of transformer 18 (side 18A) ("power train") comprising a full-bridge switcher circuit 220A containing controlled switching devices 4, 5, 6, 7 that include . . . anti-parallel diodes 8, 9, 10, and 11" and is connected to the first metallic coil (inductor 17) as shown in FIG. 1 ("power train including a first switching circuit coupled to said first metallic coil"). (Ex. PA-5, 6:8-14, FIG. 1.) *Anguelov* also discloses "controlled switching devices 21 and 22 that include embedded, or external, anti-parallel diodes 23 and 24" ("a second switching circuit") that is connected to the second metallic coil (inductor 19). (Ex. PA-5, 6:36-43, 6:51-53, FIG. 1.)

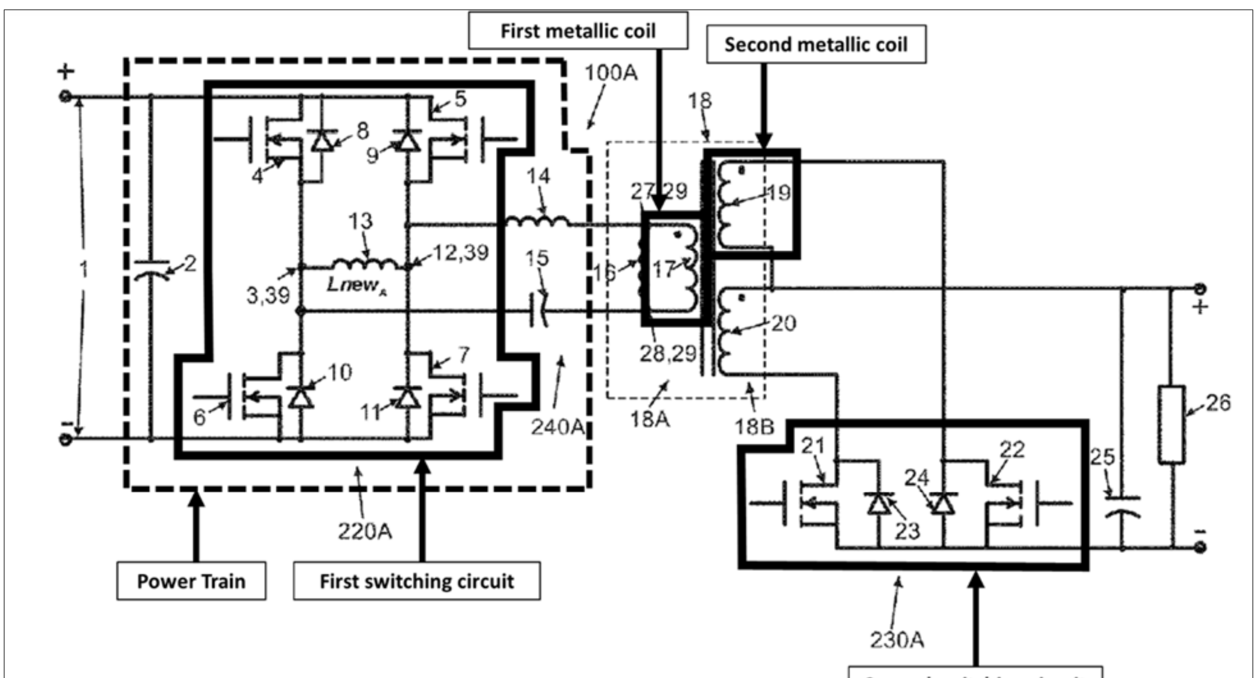


FIG. 1

(Ex. PA-5, FIG. 1 (annotated).)

Anguelov discloses that the system in Figure 1 has a resonant topology. For example, *Anguelov* refers to the topology as a "resonant network" or "resonant configuration[]," as having "resonant components" including "inductors 13, 14, 16 and capacitor 15" in the left hand side apparatus, and describes the "characteristics of the resonant circuit." (Ex. PA-5, 7:36-48, 8:34-38, 8:44-48, 8:55-65.)

The modification of *Anguelov* in view of *Jang* described above in Section VII.U.2.b for claim 1 does not change this analysis. (Ex. PA-DEC, ¶332.)

4. Claim 10

a. The apparatus as recited in claim 7 further comprising a capacitor selected to produce substantially zero-current switching of said first switching circuit in said power train in conjunction with an inductor.

Anguelov in view of *Jang* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶333-336.) *Anguelov*, as modified by *Jang*, discloses the limitations of claim 7. (*See supra* Section VII.U.3.a.)

Anguelov further discloses that the "**resonant components** of the LLC **converter can be selected** (in relation to the operating frequency) **in such a way that the converter will provide . . . zero current switching (ZCS)** for the switching devices connected to load" ("a capacitor selected to produce substantially zero-current switching") (Ex. PA-5, 7:4-11.) Anguelov explains that the "resonant components" of the Figure 1 embodiment include "capacitor 15" ("a capacitor") among other components (*id.*, 7:36-48), and that the embodiment of Figure 1 can be configured for ZCS operation (*id.*, 19:17-39.) Putting these disclosures together, a POSITA would have understood that Anguelov discloses selecting capacitor 15, a resonant component, so that the converter will provide zero current switching. (Ex. PA-DEC, ¶334.) Moreover, *Anguelov* explains that "[z]ero-voltage switching (ZVS) and zero-current switching (ZCS) are well established switching techniques for reducing switching losses which in turn allows for higher switching frequencies, reduced size of magnetic components, increased power density and reduced cost." (Ex. PA-5 at 1:33-40.)

Regardless of the direction of power flow in Figure 1, power flows through the first switching circuit (switches 4-7) and through transformer 18, including winding 17 ("an inductor"). (Ex. PA-5, FIG. 1 (schematically representing winding 17 as an inductor), 6:6-29, 6:54-67; *see* *also id.*, FIGs. 8, 9.) The transformer windings, which include coil 17, also impact the ZCS switching operation. (*See id.*, 10:33-39.) Therefore, *Anguelov* discloses a capacitor (capacitor 15) selected to produce substantially zero-current switching (ZCS) in said power train (as mapped for claim 7, including the first switching circuit) in conjunction with an inductor (winding 17). (Ex. PA-DEC, ¶335.)

The modification of *Anguelov* in view of *Jang* described above in Section VII.U.2.b for claim 1 does not change this analysis. (Ex. PA-DEC, ¶336.)

5. Claim 11

a. The apparatus as recited in claim 10 wherein said inductor is formed at least in part with said first metallic coil.

Anguelov in view of *Jang* discloses or suggests these limitations. (Ex. PA-DEC, ¶337.) *Anguelov*, as modified by *Jang*, discloses the limitations of claim 10. (*See supra* Section VII.U.4.a) As discussed above for claim 10, the inductor is the first metallic coil (winding 17) ("wherein said inductor is formed at least in part with said first metallic coil"). (*Id.*)

The modification of *Anguelov* in view of *Jang* described above in Section VII.U.2.b for claim 1 does not change this analysis. (Ex. PA-DEC, ¶338.)

6. Claim 12

a. The apparatus as recited in claim 7 wherein said power train is configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit.

Anguelov in view of *Jang* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶339-341.) As described above for claim element 1[c], *see supra* Section VII.U.2.c, *Anguelov* discloses charging and discharging a battery through a transformer. And as described above for claim 7, *Anguelov* discloses a first switching circuit (full-bridge switcher circuit 220A) and a second switching circuit (switching devices 21 and 22). (*See supra* Section VII.U.3.a.)

Anguelov further discloses that when power is transferred from DC voltage source 1 ("battery") to load 26, "[s]witching devices 4, 5, 6, and 7 [of full-bridge switcher circuit 220A] are turned on and off with approximately **50% duty cycle** width" and "[s]witching devices 21 and 22 are controlled in a synchronous rectification manner with approximately **50% duty cycle** . . . ." (Ex. PA-5, 6:19-23, 6:44-47 (emphasis added).) And, "[i]n the case of power transfer from the right hand side to [the] left hand side," when "load impedance 26 becomes a DC voltage source, while DC voltage source 1 becomes a load," the "full bridge switcher circuit 220A becomes a synchronously controlled rectifier circuit with approximately **50% duty cycle**" and "switching devices 21 and 22 become a push-pull controlled switcher with . . . approximately **50% duty cycle** . . ." ("configured to enable said battery to be successively charged and discharged without changing a duty cycle of said first switching circuit and said second switching circuit"). (Ex. PA-5, 6:54-67 (emphasis added)).

In other words, when the battery is discharged (i.e., power flows out of DC voltage source 1), the duty cycle of both the first switching circuit (full-bridge switcher circuit 220A) and the second switching circuit (switches 21 and 22) is 50%, and when power flow reverses direction to successively charge the battery (i.e., power flows into DC voltage source 1), the duty cycle of both the first switching circuit and the second switching circuit is also 50%, and thus no duty cycle of either the first switching circuit or the second switching circuit has changed. (Ex. PA-DEC, ¶341.)

7. Claim 15

a. [15.a] A system, comprising:

To the extent the preamble is limiting, *Anguelov* discloses this limitation. (Ex. PA-DEC, ¶342.) Specifically, *Anguelov* discloses "[a] resonant, bi-directional, DC to DC voltage converter," such as the "bidirectional converter 100A embodying the principles of the invention [and] shown in FIG. 1." (Ex. PA-5, 6:6-8, FIG. 1.) The converter includes a "left hand side of the circuitry," *i.e.*, the circuitry on the left side of transformer 18 in Figure 1, and a "right hand side of the circuitry," on the right side of transformer 18 (together, "a system"). (Ex. PA-5, 6:6-11, 6:27-29, 6:54-57, FIG. 1.)

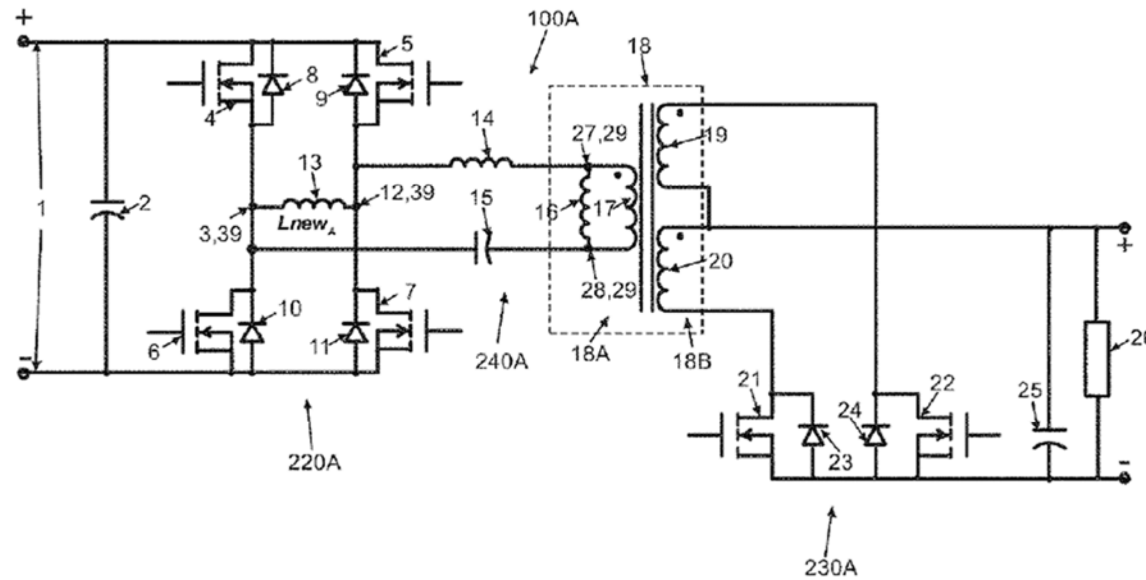


FIG. 1

(Ex. PA-5, FIG. 1.)

b. [15.b] a wireless battery interface including a wireless battery interface magnetic core piecepart; and a wireless battery, including: a wireless battery magnetic core piecepart configured to be coupled to, aligned with and removable from said wireless battery interface magnetic core piecepart to form a transformer;

Anguelov in view of *Jang* discloses or suggests the limitations of claim 15. (Ex. PA-DEC, ¶¶343-356.) Claim 15 largely tracks claim 1, except that it recites a system instead of an apparatus, and uses different nomenclature. As detailed below, the "wireless battery" refers to the circuit on the side of the transformer connected to a battery (claimed "wireless battery including . . . a battery"), and the "wireless battery interface" is on the other side of the transformer, and need not include a battery. (Ex. '067 Patent, Claim 15; *see also id.*, 5:20-22 ("FIG. 2 illustrate[s] . . . a schematic diagram of an embodiment of a power system with a wireless battery 200 and a wireless battery interface 250.").)

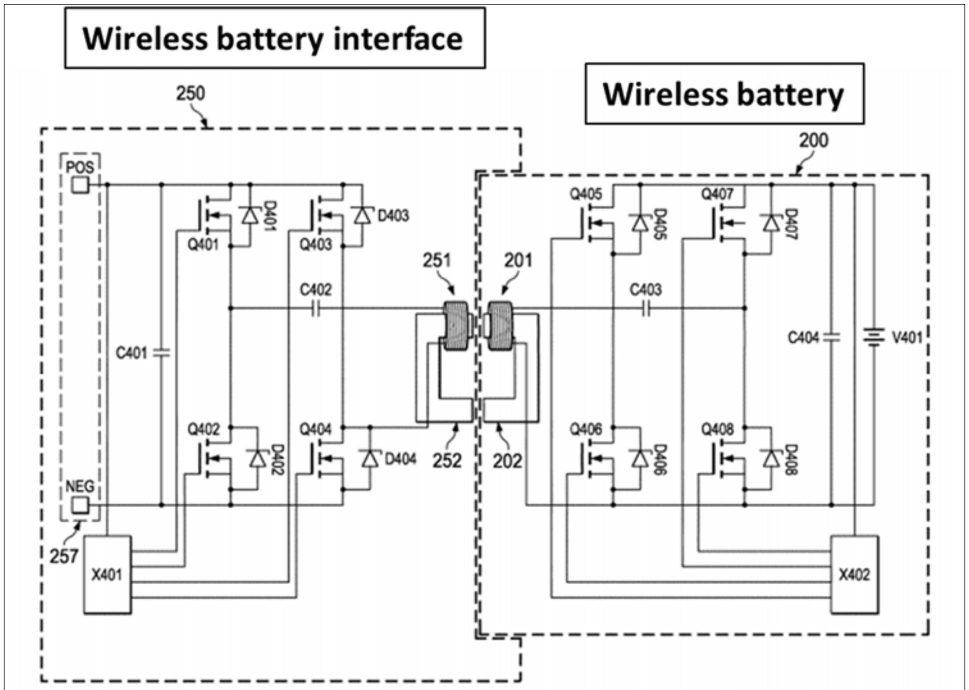


FIG. 2

(Ex. ’067 Patent, FIG. 2 (annotated).)

Anguelov, as modified by *Jang* (discussed for claim 1, *supra* Section VII.U.2.b-c), and discussed below for this limitation 15[b], discloses a wireless battery interface and wireless battery, as identified in annotated Figure 1 below. (Ex. PA-5, FIG. 1.)

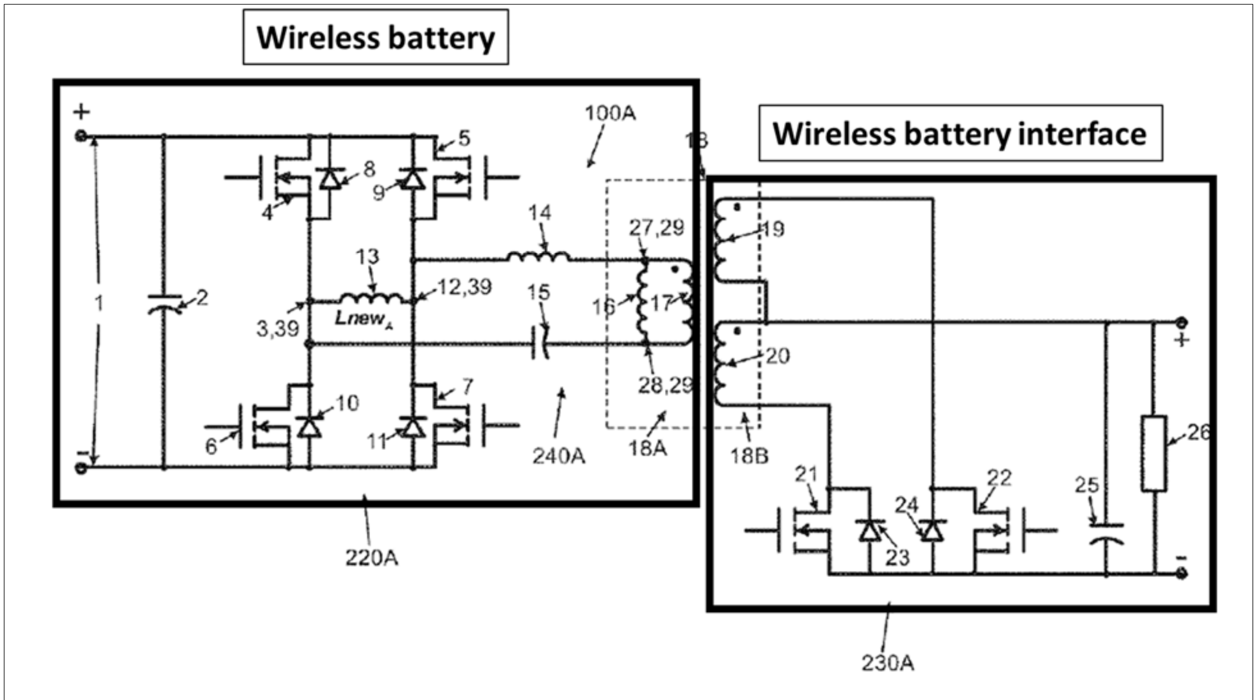


FIG. 1

(Ex. PA-5, FIG. 1 (annotated).)

Anguelov discloses primary winding 17 located on the primary side 18A of transformer 18 and "secondary winding[] 19 . . . located on the secondary side 18B of transformer 18." (Ex. PA-5, 6:27-29, 6:34-43.) *Anguelov* further discloses that transformer 18 has a "magnetic structure." (*Id.*, 6:33 ("magnetic structure of transformer 18").) Transformer 18 is depicted having two vertical lines between the left side 18A and the right side 18B. (Ex. PA-5, FIG. 1.) From these vertical lines and the description of transformer 18 as a transformer having a "magnetic structure" a POSITA would have understood that the transformer coils are wound around an iron core ("first metallic coil encircling at least a portion thereof"; "second metallic coil encircling at least a portion thereof"). (Ex. PA-DEC, ¶345.)

Schaum's Outline of Theory and Problems of Basic Circuit Analysis ("*Schaum*")[4] confirms how a POSITA would have understood *Anguelov*'s disclosure of transformer 18 having a magnetic structure because it describes how a "typical" transformer has windings wound around a magnetic core:

[4] *Schaum* is referred to herein solely to show how a POSITA would have understood *Anguelov*'s disclosures.

> A *transformer* has two or more windings, also called coils, that are magnetically coupled. As shown in Fig. 16-1, a typical transformer has two windings wound on a core that may be made from iron. Each winding encirclement of the core is called a *turn*, and is designated by *N*. Here, winding 1 has $N_1 = 4$ turns and winding 2 has $N_2 = 3$ turns . . . . [W]inding 1 is called the *primary winding* or just *primary,* and winding *2* is called the *secondary winding* or just *secondary.*

(Ex. PA-15, 349; *see also id.* FIG. 16-1.)

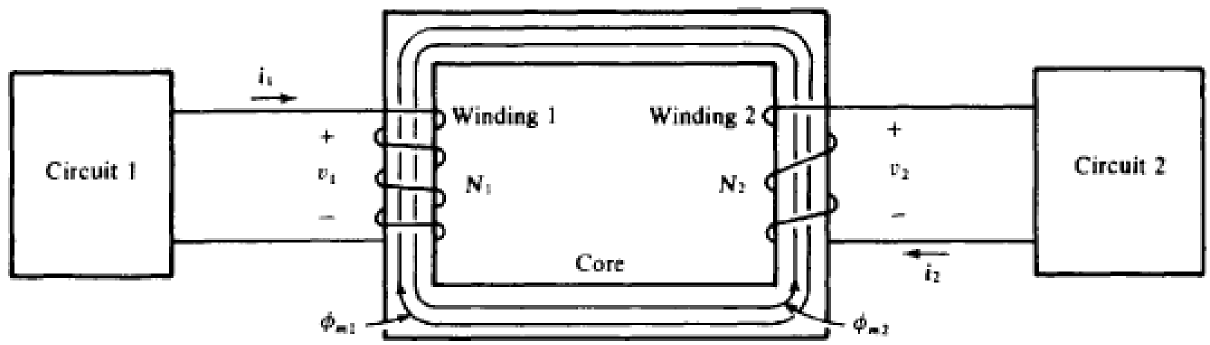


Fig. 16-1

(*Id.*, FIG. 16-1.)

Schaum further explains that a transformer core confines flux to the core so that it passes through or couples the coil winding on the opposite side of the transformer:

> In the operation, current $\boldsymbol{i_1}$ flowing in winding 1 produces a magnetic flux ϕ_{m1} that, for power transformers, is ideally confined to the core and so passes through or couples winding 2. The *m* in the subscript means "mutual"– the flux is *mutual* to both windings. Similarly, current i_2, flowing in winding 2 produces a flux ϕ_{m2} that couples winding 1. When these currents change in magnitude or direction, they produce corresponding changes in the fluxes and these changing fluxes induce voltages in the windings. In this way, the transformer couples circuit 1 and circuit 2 so that electric energy can flow from one circuit to the other.

(Ex. PA-15, 349; *see also id.*, FIG. 16-1.)

Schaum also explains that a schematic of an inductor having two vertical lines between the inductor symbols (like *Anguelov*'s transformer 18), represents an iron-core transformer: "In Fig. 16-31, the two vertical lines between the inductor symbols designate the transformer as either **an**

iron-core transformer or an ideal transformer." (Ex. PA-15, 349 (emphasis added), *see also id.*, FIG. 16-3.)

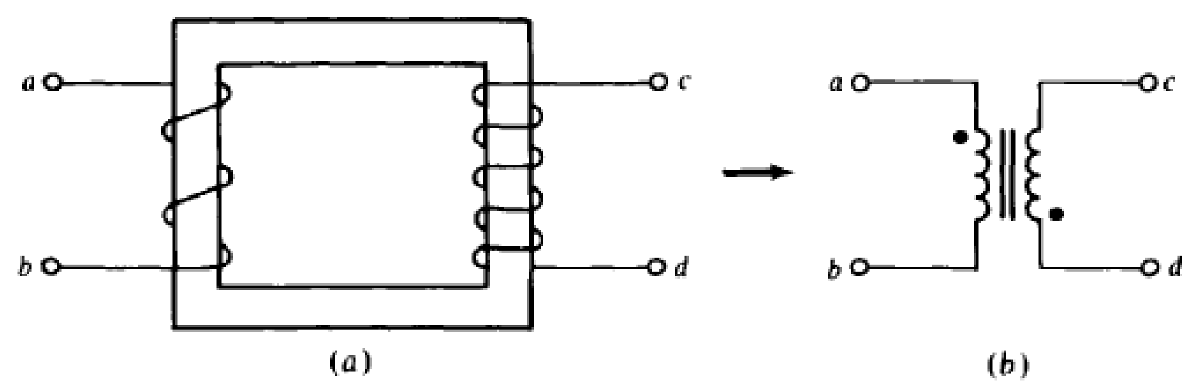


Fig. 16-3

(*Id.*, FIG. 16-3.)

Consistent with *Schaum*'s explanation of transformer terminology, including that transformers are formed from inductors having windings around an iron core and that an iron-core transformer is represented in a circuit diagram with two vertical lines, as in *Anguelov*'s Figure 1, a POSITA would have understood from *Anguelov*'s disclosure that its transformer windings were wound around cores ("encircling at least a portion thereof"). (Ex. PA-DEC, ¶349.)

Although *Anguelov* discloses a first metallic coil and a second metallic coil each encircling a magnetic core piecepart, *Anguelov* does not disclose that the coils encircle different magnetic core pieceparts (i.e., a "wireless battery interface magnetic core piecepart" and a "wireless battery magnetic core piecepart") where a first magnetic core piecepart is configured to be coupled to, aligned with, and removable from a second magnetic core piecepart. However, in view of *Jang*, it would have been obvious, and a POSTIA would have been motivated, to incorporate these features into *Anguelov*. (Ex. PA-DEC, ¶350.)

Jang discloses in an analogous power converter, a transformer T having two inductors, and describes in an exemplary embodiment that such a transformer in a power converter can be "built using ferrite cores (2624Z)." (Ex. PA-1, 7:14-24.) Moreover, *Jang*'s power converter is wireless (what *Jang* calls "contactless electrical energy transmission" or "CEET"), and in such a system a POSITA would have understood that a transformer should be made from two halves, otherwise the apparatus that is being wirelessly charged or discharged would be fixed to the other apparatus, generally defeating the benefits of wireless charging. Thus, a POSITA implementing *Anguelov*'s apparatus in a wireless fashion like *Jang*'s would have been motivated to have *Anguelov*'s winding 17 and winding 19 wound around separate magnetic cores ("wireless battery magnetic core piecepart" for winding 17, and "wireless battery interface magnetic core piecepart" for winding 19) to facilitate the wireless power transfer functionality disclosed by *Jang* and discussed in more detail in Sections VII.A.1, and VII.A.3.b. (*See supra* Section VII.A.1, VII.A.3.b.)

For the reasons discussed in Section VII.A.3.b, *Jang* further discloses that the cores implemented in an apparatus configured for wireless power such as the *Anguelov*'s apparatus, as modified by *Jang*, would be configured to be coupled to, aligned with, and removable from one another. (*Supra* Section VII.A.3.b.) This type of transformer configuration, with separate core pieces, each having a coil winding around them, was well-known in the art. (*See e.g.*, Ex. PA-7, 2, FIG. 1 (illustrating an example of primary and secondary "winding[s]" of a wireless transformer, wherein the windings wrap around magnetic structures of the transformer); Ex. PA-13, 12:31-59, FIGs. 1A-C (same); Ex. PA-14, 1:22-32 ("Inductive chargers have . . . been proposed in a number of documents such as U.S. Pat. No. 6,356,049, U.S. Pat. No. 6,301,128, U.S. Pat. No. 6,118,249. These inductive chargers . . . use traditional transformer designs with windings wound around ferrite magnetic cores."); Ex. PA-DEC, ¶352.)

Anguelov's core, as modified in view of *Jang* to be two iron cores, would also satisfy the constructions for "magnetic core piecepart" for the reasons discussed above in this section (confining flux so that flux paths from one core pass through the other core and through both coils), and for those reasons discussed in Section VII.A.3.b with respect to *Jang*. (*Supra* Section VII.A.3.b.)

A POSITA would have been motivated, and would have found it obvious, to configure *Anguelov*'s power converter for wireless power transfer with the modifications discussed above from *Jang*. For example, a POSITA would have found motivation in *Jang*'s disclosure of the benefits of wireless power transfer:

> In many applications, the contactless electrical energy transmission (CEET) has distinct advantages over the conventional energy transmission system which uses wires and connectors. For example, the CEET has been the preferred power-delivery approach in hazardous applications such as mining and underwater environments due to the elimination of the sparking and the risk of electrical shocks [1]. Also, a number of CEET systems have been developed for electric vehicle battery-recharging applications because of their potential enhanced safety, reliability, and

> convenience. In addition, the CEET has been considered in medical applications since it makes possible to transfer electric energy, which is required for running implanted electrical circulatory assist devices, through the intact skin of a patient [2]. Finally, the CEET has been used in cordless electric tooth brushes and portable telephones to increase their reliability by eliminating the contacts between their battery charger and the battery.

(Ex. PA-1, 1:11-29.)

A POSITA would have recognized that *Anguelov*'s apparatus, in a similar power converter field to *Jang*, could similarly provide these benefits if it were modified so that the two halves of its transformer cores were able to be removed from one another so that it was configured to be used for wireless power transfer like *Jang*. (Ex. PA-DEC, ¶355.) *First*, like *Anguelov*, *Jang* discloses bidirectional power flow between a source and a load, where power is transferred from one side to the other through a transformer. *Second*, *Jang* discloses that "any resonant topology can be employed" and thus a POSTIA would have expected that the resonant topology of *Anguelov*'s Figure 1 apparatus could be employed in a contactless or wireless power transfer application like *Jang* discloses. (*See e.g.*, Ex. PA-5 7:36-38 ("Referring back to FIG. 1, the network of inductors 13, 14, 16 and capacitor 15 are employed in resonant network circuit 240A.") *Third*, *Anguelov*'s Figure 1 circuit, like *Jang*'s Figure 10 circuit, discussed above (*see generally supra* Section VII.A) is configured with a full-bridge switching circuit on one side and a half-bridge switching circuit on the other. Given the similarity between the disclosures, and the advantages *Jang* teaches about contactless energy transfer in wireless applications, a POSITA would have been motivated, and found it obvious, to modify *Anguelov*'s power converter to have "a first metallic coil encircling at least a portion thereof and configured to be coupled to, aligned with and removable from a second magnetic core piecepart having a second metallic coil encircling at least a portion thereof."

For the reasons discussed above (*e.g.*, similarity of the *Anguelov* and *Jang* circuitry and function, and *Jang*'s disclosure that any resonant topology could be employed), a POSITA would have had a reasonable expectation of success in the combination. Such a combination would have been combining a known technique (wireless power transfer using separate cores for each coil as taught by *Jang*) to improve a similar device (*Anguelov*'s bi-directional power converter having one transformer core) in the same way (*e.g.*, a modification to make *Anguelov*'s apparatus wireless). Such a modification would have been well within a POSITA's skill, as would any other modifications necessary to implement the combination. (Ex. PA-DEC, ¶356.)

c. [15.c] a wireless battery, including: . . . a battery metallically coupled to a first metallic coil encircling at least a portion of said wireless battery magnetic core piecepart and configured to be charged and discharged through an electrically isolating path of said transformer.

Anguelov in view of *Jang* discloses or suggests these limitations. (Ex. PA-DEC, ¶357.) As discussed for claim elements 1[b], 1[c] and 15[b], *supra* Sections VII.U.2.b-c, VII.U.7.b, *Anguelov* as modified by *Jang* discloses a first metallic coil (*Anguelov*'s inductor 17), with a battery (DC voltage source 1) metallically coupled to the first metallic coil. And as discussed above for claim element 1[c], *supra* Section VII.U.2.c, the battery in *Anguelov*'s system as modified by *Jang* is configured to be charged and discharged through an electrically isolating path of a transformer (discussed in claim 1 with reference to the apparatus as modified by *Jang*).

8. Claim 16

a. The system as recited in claim 15 further comprising a power train including a first switching circuit of said wireless battery configured to form a portion of a resonant topology with a with a second switching circuit of said wireless battery interface.

Anguelov and *Jang* disclose or suggest the limitations of claim 16 for the same reasons presented above for claim 7. (*See supra*, Section VII.U.3.a; Ex. PA-DEC, ¶358.)

9. Claim 17

a. The system as recited in claim 16 wherein said first switching circuit is configured to be operated with a first duty cycle and said second switching circuit is configured to be operated with a second duty cycle, said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle.

Anguelov in view of *Jang* discloses or suggests these limitations. (Ex. PA-DEC, ¶¶359-362.) As described above for claim element 15[b] and 15[c], *Anguelov* discloses charging and discharging a battery through a transformer. (*See supra* Sections VII.U.7.b-c.) And as described above for claim 16 (with reference to claim 7), *Anguelov* discloses a first switching circuit (full-bridge switcher circuit 220A) and a second switching circuit (switching devices 21 and 22). (*See supra* Section VII.U.8.a.)

Anguelov further discloses that when power is transferred from DC voltage source 1 ("battery") to load 26, "[s]witching devices 4, 5, 6, and 7 [of full-bridge switcher circuit 220A] are turned on and off with approximately **50% duty cycle** width" ("said first switching circuit is configured to be operated with a first duty cycle") and "[s]witching devices 21 and 22 are controlled in a synchronous rectification manner with approximately **50% duty cycle** . . ." ("said second switching circuit is configured to be operated with a second duty cycle") . (Ex. PA-5, 6:19-23, 6:44-47 (emphasis added).) And, "[i]n the case of power transfer from the right hand side to [the] left hand side," when "load impedance 26 becomes a DC voltage source, while DC voltage source 1 becomes a load," the "full bridge switcher circuit 220A becomes a synchronously controlled rectifier circuit with approximately **50% duty cycle**" and "switching devices 21 and 22 become a push-pull controlled switcher with . . . approximately **50% duty cycle** . . ." ("said first duty cycle and said second duty cycle being controlled to enable a bidirectional power flow between said wireless battery and said wireless battery interface without altering said first duty cycle and said second duty cycle"). (Ex. PA-5, 6:54-67 (emphasis added)).

In other words, when power flows from DC voltage source 1 in the wireless battery to load impedance 26 in the wireless battery interface, the duty cycle of both the first switching circuit (full-bridge switcher circuit 220A) and the second switching circuit (switches 21 and 22) is 50%, and when power flow reverses direction to flow from load impedance 26 to DC voltage source 1 the duty cycle of both the first switching circuit and the second switching circuit is also 50%. Thus, the duty cycles are controlled to remain at 50% to enable bidirectional power flow between the wireless battery and wireless battery interface without altering the first or second duty cycle from 50%. (Ex. PA-DEC, ¶361.)

The modification of *Anguelov* in view of *Jang* described above in Section VII.U.2.b for claim 1 does not change this analysis. (Ex. PA-DEC, ¶362.)

VIII. Detailed Explanation of the Pertinence and Manner of Applying the Prior Art to the Claims

A. Bases for Proposed Rejections of the Claims

The following is a quotation of pre-AIA 35 U.S.C. § 102 that forms the basis for all of the identified prior art:

> A person shall be entitled to a patent unless...
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States, or . . .
>
> (e) the invention was described in — (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language . . . .

The following is a quotation of pre-AIA 35 U.S.C. § 103(a) that forms the basis of all of the following obviousness rejections:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negative by the manner in which the invention was made.

The question under 35 U.S.C. § 103 is whether the claimed invention would have been obvious to one of ordinary skill in the art at the time of the invention. In *KSR International Co. v. Teleflex Inc*., 550 U.S. 398 (2007), the Court mandated that an obviousness analysis allow for "common sense" and "ordinary creativity," while at the same time not requiring "precise teachings directed to the specific subject matter of the challenged claim[s]." *KSR Int'l Co.*, 550 U.S. at 418, 420-421. According to the Court, "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Id.,* 416. In particular, the Court emphasized "the need for caution in granting a patent based on the combination of elements found in the prior art." *Id.,* 401. The Court also stated that "when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." *Id.,* 417.

The Office has provided further guidance regarding the application of *KSR* to obviousness questions before the Office.

> If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

MPEP § 2141(I) (quoting *KSR* at 417.)

The MPEP identifies many exemplary rationales from *KSR* that may support a conclusion of obviousness. Some examples that may apply to this reexamination include:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices in the same way;
- Applying a known technique to improve devices in the same way;
- Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success ("obvious to try")

MPEP § 2141(III).

In addition, the Office has published *Post-KSR* Examination Guideline Updates. *See* Fed. Reg. Vol. 75, 53464 (the "Guideline Updates".) The Guideline Updates discuss developments after *KSR* and provide teaching points from recent Federal Circuit decisions on obviousness. Some examples are listed below:

> A claimed invention is likely to be obvious if it is a combination of known prior art elements that would reasonably have been expected to maintain their respective properties or functions after they have been combined.

Id., 53646.

> A combination of known elements would have been prima facie obvious if an ordinary skilled artisan would have recognized an apparent reason to combine those elements and would have known how to do so.

Id., 53648.

> Common sense may be used to support a legal conclusion of obviousness so long as it is explained with sufficient reasoning.

Id.

B. Proposed Rejections

Pursuant to 37 C.F.R. § 1.510(b)(2), Requester identifies claims 1, 7-12, and 15-17 as the claims for which reexamination is requested. The proposed rejections below, in conjunction with the analysis in Sections V-VI above and the attached declaration of Dr. Baker (Ex. PA-DEC), provide a detailed explanation of the pertinence and manner of applying the prior art to each of claims 1, 7-12, and 15-17.

1. Proposed Rejection #1

Claims 1, 7, 9, 15, and 16 are obvious over *Jang* in view of *Brockmann* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang* and *Brockmann* above in Section VII.A and the declaration of Dr. Baker provided in Exhibit PA-DEC.

2. Proposed Rejection #2

Claim 8 is obvious over *Jang* in view of *Brockmann* and *Yang* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Brockmann*, and *Yang* above in Section VII.B and the declaration of Dr. Baker provided in Exhibit PA-DEC.

3. Proposed Rejection #3

Claim 9 is obvious over *Jang* in view of *Brockmann* and *Kardolus* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Brockmann*, and *Kardolus* above in Section VII.C and the declaration of Dr. Baker provided in Exhibit PA-DEC.

4. Proposed Rejection #4

Claims 10 and 11 are obvious over *Jang* in view of *Brockmann* and *Lee* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Brockmann*, and *Lee* above in Section VII.D and the declaration of Dr. Baker provided in Exhibit PA-DEC.

5. Proposed Rejection #5

Claims 12 and 17 are obvious over *Jang* in view of *Brockmann* and *Madawala* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Brockmann*, and *Madadwala* above in Section VII.E and the declaration of Dr. Baker provided in Exhibit PA-DEC.

6. Proposed Rejection #6

Claims 1, 7, 9, 15, and 16 are obvious over *Jang* in view of *Soar* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang* and *Soar* above in Section VII.F and the declaration of Dr. Baker provided in Exhibit PA-DEC.

7. Proposed Rejection #7

Claim 8 is obvious over *Jang* in view of *Soar* and *Yang* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Soar*, and *Yang* above in Section VII.G and the declaration of Dr. Baker provided in Exhibit PA-DEC.

8. Proposed Rejection #8

Claim 9 is obvious over *Jang* in view of *Soar* and *Kardolus* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Soar*, and *Kardolus* above in Section VII.H and the declaration of Dr. Baker provided in Exhibit PA-DEC.

9. Proposed Rejection #9

Claims 10 and 11 are obvious over *Jang* in view of *Soar* and *Lee* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Soar*, and *Lee* above in Section VII.I and the declaration of Dr. Baker provided in Exhibit PA-DEC.

10. Proposed Rejection #10

Claims 12 and 17 are obvious over *Jang* in view of *Soar* and *Madawala* under 35 U.S.C. § 103(a), as shown by the discussion of *Jang*, *Soar*, and *Madawala* above in Section VII.J and the declaration of Dr. Baker provided in Exhibit PA-DEC.

11. Proposed Rejection #11

Claims 1, 7, 15, and 16 are obvious over *Jeong* in view of *Chao* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong* and *Chao* above in Section VII.K and the declaration of Dr. Baker provided in Exhibit PA-DEC.

12. Proposed Rejection #12

Claim 8 is obvious over *Jeong* in view of *Chao* and *Yang* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Chao*, and *Yang* above in Section VII.L and the declaration of Dr. Baker provided in Exhibit PA-DEC.

13. Proposed Rejection #13

Claim 9 is obvious over *Jeong* in view of *Chao* and *Kardolus* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Chao*, and *Kardolus* above in Section VII.M and the declaration of Dr. Baker provided in Exhibit PA-DEC.

14. Proposed Rejection #14

Claims 10 and 11 are obvious over *Jeong* in view of *Chao* and *Lee* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Chao*, and *Lee* above in Section VII.N and the declaration of Dr. Baker provided in Exhibit PA-DEC.

15. Proposed Rejection #15

Claims 12 and 17 are obvious over *Jeong* in view of *Chao* and *Madawala* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Chao*, and *Madawala* above in Section VII.O and the declaration of Dr. Baker provided in Exhibit PA-DEC.

16. Proposed Rejection #16

Claims 1, 7, 15, and 16 are obvious over *Jeong* in view of *Soar* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong* and *Soar* above in Section VII.P and the declaration of Dr. Baker provided in Exhibit PA-DEC.

17. Proposed Rejection #17

Claim 8 is obvious over *Jeong* in view of *Soar* and *Yang* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Soar*, and *Yang* above in Section VII.Q and the declaration of Dr. Baker provided in Exhibit PA-DEC.

18. Proposed Rejection #18

Claim 9 is obvious over *Jeong* in view of *Soar* and *Kardolus* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Soar*, and *Kardolus* above in Section VII.R and the declaration of Dr. Baker provided in Exhibit PA-DEC.

19. Proposed Rejection #19

Claims 10 and 11 are obvious over *Jeong* in view of *Soar* and *Lee* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Soar*, and *Lee* above in Section VII.S and the declaration of Dr. Baker provided in Exhibit PA-DEC.

20. Proposed Rejection #20

Claims 12 and 17 are obvious over *Jeong* in view of *Soar* and *Madawala* under 35 U.S.C. § 103(a), as shown by the discussion of *Jeong*, *Soar*, and *Madawala* above in Section VII.T and the declaration of Dr. Baker provided in Exhibit PA-DEC.

21. Proposed Rejection #21

Claims 1, 7, 10, 11, 12, 15, 16, and 17 are obvious over *Anguelov* in view of *Jang* under 35 U.S.C. § 103(a), as shown by the discussion of *Anguelov and Jang* above in Section VII.U and the declaration of Dr. Baker provided in Exhibit PA-DEC.

IX. Conclusion

For the reasons set forth above, the Requester has established at least one substantial new question of patentability with respect to claims 1, 7-12, and 15-17 of the '067 patent. The analysis provided in this Request and in the declaration of Dr. Baker demonstrates the invalidity of claims 1, 7-12, and 15-17 in view of prior art that was not substantively considered by the Patent Office. Therefore, it is requested that this request for reexamination be granted and claims 1, 7-12, and 15-17 be cancelled.

As identified in the attached Certificate of Service and in accordance with 37 C.F.R. §§ 1.33(c) and 1.510(b)(5), a copy of this Request has been served, in its entirety, to the address of the attorney of record.

Respectfully submitted,

PAUL HASTINGS LLP

Dated: August 30, 2021

By: /Naveen Modi/
Naveen Modi
Reg. No. 46,224