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(19) **United States**

(12) **Patent Application Publication**  
**Vogel**

(10) **Pub. No.: US 2014/0268931 A1**  
(43) **Pub. Date: Sep. 18, 2014**

(54) **POWER CONVERSION SYSTEM WITH A DC TO DC BOOST CONVERTER**

(52) **U.S. Cl.**  
CPC ..... *H02M 3/04* (2013.01); *H02M 7/539* (2013.01)

(71) Applicant: **Combined Energies LLC**, Latham, NY (US)

USPC ..... **363/40**; 363/131; 323/234

(72) Inventor: **John Anthony Vogel**, Charlton, NY (US)

(57) **ABSTRACT**

(73) Assignee: **Combined Energies LLC**, Latham, NY (US)

(21) Appl. No.: **14/194,773**

(22) Filed: **Mar. 2, 2014**

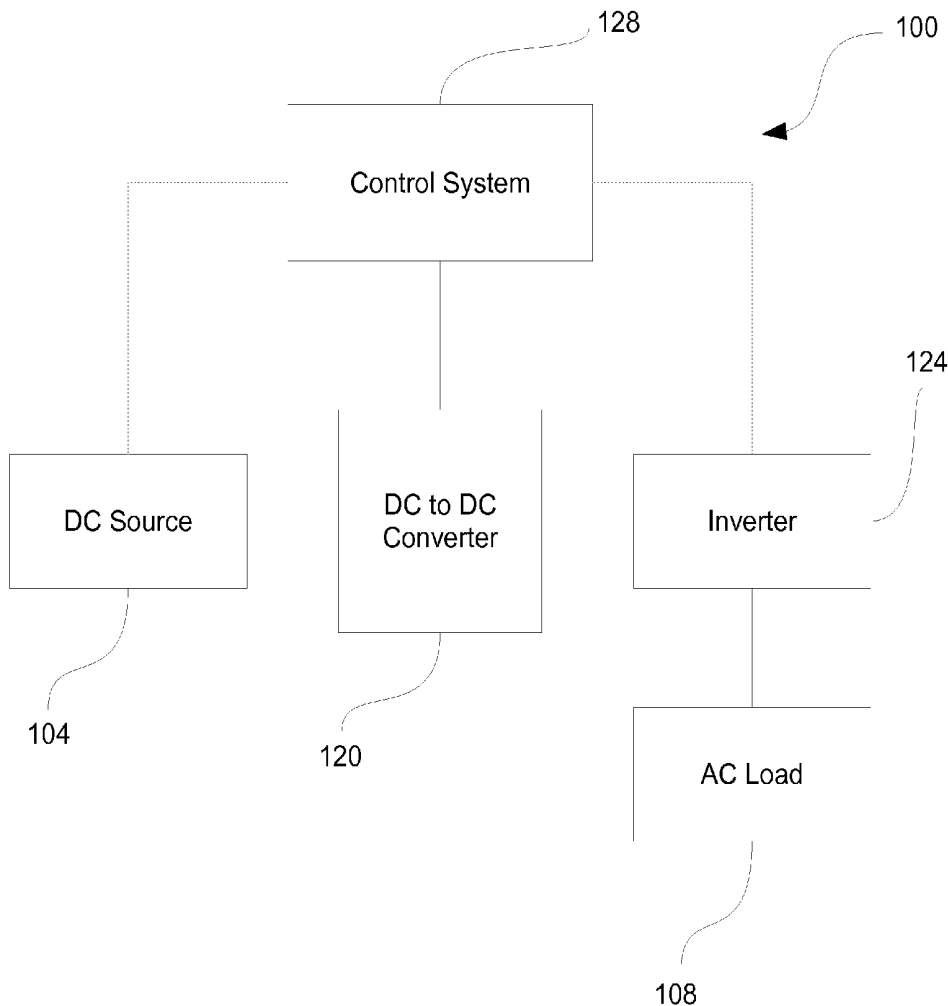
A voltage booster allowing for increased utilization of low voltage, high current, unregulated DC power ("LVDC source"), such as, but not limited to, fuel cells, batteries, solar cells, wind turbines, and hydro-turbines. LVDC generation systems employing a variable low voltage DC-DC converter of the present disclosure may be used without a power inverter in applications requiring high voltage DC inputs and can also allow for the employment of common, low cost, reliable, low voltage energy storage chemistries (operating in the 12-48 VDC range) while continuing to employ the use of traditional inverters designed for high voltage power supplies. An embodiment of the DC boost converter includes a plurality of interleaved, isolated, full-bridge DC-DC converters arranged in a Delta-Wye configuration and a multi-leg bridge.

**Related U.S. Application Data**

(60) Provisional application No. 61/781,965, filed on Mar. 14, 2013.

**Publication Classification**

(51) **Int. Cl.**  
*H02M 3/04* (2006.01)  
*H02M 7/539* (2006.01)





US010320018B2

(12) **United States Patent**  
**Staudt et al.**

(10) **Patent No.:** **US 10,320,018 B2**  
(45) **Date of Patent:** **Jun. 11, 2019**

(54) **DYNAMICALLY RESPONSIVE HIGH EFFICIENCY CCHP SYSTEM**

(58) **Field of Classification Search**  
None  
See application file for complete search history.

(71) Applicant: **Combined Energies LLC**, Latham, NY (US)

(56) **References Cited**

(72) Inventors: **Rhonda Lee Staudt**, Niskayuna, NY (US); **Donald Frank Rohr**, Rexford, NY (US); **John Anthony Vogel**, Charlton, NY (US)

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(73) Assignee: **Combined Energies, LLC**, Latham, NY (US)

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 649 days.

EP 0 409 226 A2 1/1991  
EP 0 409 226 A3 1/1991  
WO 2016020192 A1 2/2016

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(21) Appl. No.: **14/142,873**

Pham, Emily P., USPTO Non-Final Office Action related to U.S. Appl. No. 14/194,773, dated Dec. 4, 2015.  
(Continued)

(22) Filed: **Dec. 29, 2013**

(65) **Prior Publication Data**

US 2014/0272656 A1 Sep. 18, 2014

**Related U.S. Application Data**

(60) Provisional application No. 61/788,300, filed on Mar. 15, 2013, provisional application No. 61/788,532, (Continued)

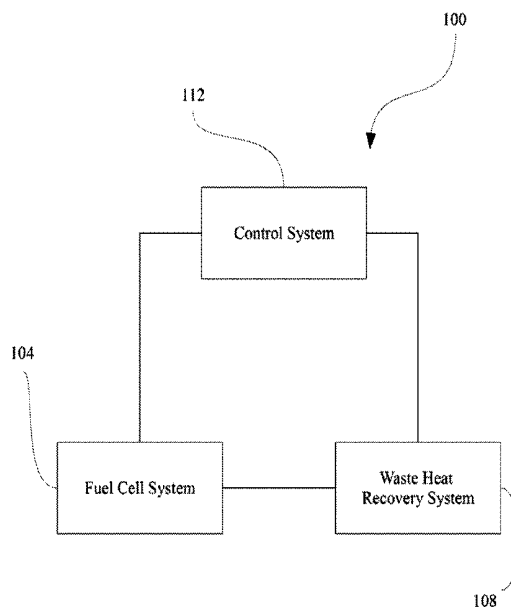
(51) **Int. Cl.**  
**H01M 8/04007** (2016.01)  
**H01M 8/04** (2016.01)  
(Continued)

(57) **ABSTRACT**

A highly efficient combined cooling, heating, and power (CCHP) system is capable of providing 100% utilization of an energy generator used by the system by distributing thermal and electrical outputs of the energy generator to loads and/or other storage apparatuses. The CCHP system includes an energy generator, which can be a fuel cell and a waste heat recovery unit that assists in recovering thermal energy from the energy generator and returning it to the energy generator, and/or providing it to a thermal load, or a storage as needed or desired.

(52) **U.S. Cl.**  
CPC ..... **H01M 8/0675** (2013.01); **B01D 53/02** (2013.01); **B01D 53/0454** (2013.01);  
(Continued)

**16 Claims, 7 Drawing Sheets**



(19)



(11)

**EP 3 316 467 A2**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**02.05.2018 Bulletin 2018/18**

(51) Int Cl.:  
**H02M 3/28 (2006.01) H02J 1/10 (2006.01)**

(21) Application number: **17180992.4**

(22) Date of filing: **12.07.2017**

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 GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
 PL PT RO RS SE SI SK SM TR**  
 Designated Extension States:  
**BA ME**  
 Designated Validation States:  
**MA MD**

(72) Inventors:  
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 Slingerlands, NY 12259 (US)**

(74) Representative: **Schiffer, Axel Martin et al  
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(30) Priority: **13.07.2016 US 201615209707**

(71) Applicant: **Combined Energies LLC  
 Latham, NY 12110 (US)**

Remarks:  
 Claims 16 to 26 are deemed to be abandoned due to non-payment of the claims fees (Rule 45(3) EPC).

(54) **POWER SYSTEM FOR MULTIPLE POWER SOURCES**

(57) A voltage booster allowing for increased utilization of low voltage, high current, unregulated DC power ("LVDC source"), such as, but not limited to, fuel cells, batteries, solar cells, wind turbines, and hydro-turbines. LVDC generation systems employing a variable low voltage DC-DC converter of the present disclosure may be used without a power inverter in applications requiring high voltage DC inputs and can also allow for the em-

ployment of common, low cost, reliable, low voltage energy storage chemistries (operating in the 12-48VDC range) while continuing to employ the use of traditional inverters designed for high voltage power supplies. An embodiment of the DC boost converter includes a plurality of interleaved, isolated, full-bridge DC-DC converters arranged in a Delta-Wye configuration and a multi-leg bridge.

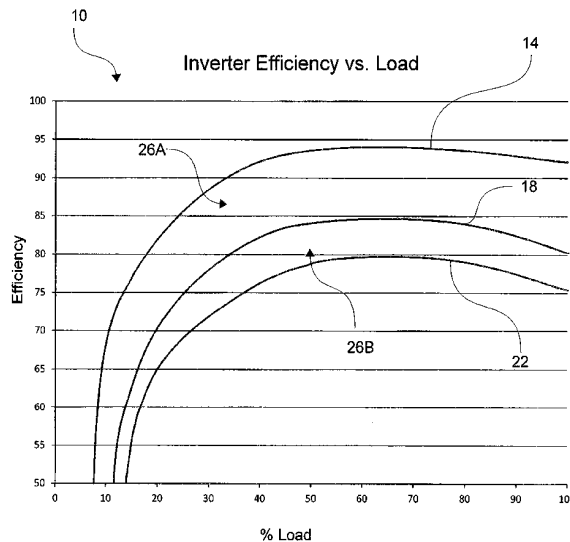


FIG. 1

**EP 3 316 467 A2**



US010404071B2

(12) **United States Patent**  
**Vogel et al.**

(10) **Patent No.:** **US 10,404,071 B2**  
(45) **Date of Patent:** **Sep. 3, 2019**

(54) **POWER SYSTEM FOR MULTIPLE POWER SOURCES**

(71) Applicants: **John Anthony Vogel**, Charlton, NY (US); **Eoin Connolly**, Slingerlands, NY (US)

(72) Inventors: **John Anthony Vogel**, Charlton, NY (US); **Eoin Connolly**, Slingerlands, NY (US)

(73) Assignee: **Combined Energies LLC**, Latham, NY (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/870,259**

(22) Filed: **Jan. 12, 2018**

(65) **Prior Publication Data**

US 2018/0138714 A1 May 17, 2018

**Related U.S. Application Data**

(63) Continuation of application No. 15/209,707, filed on Jul. 13, 2016, now Pat. No. 9,906,039, which is a (Continued)

(51) **Int. Cl.**  
**H02J 3/38** (2006.01)  
**H02J 7/00** (2006.01)  
(Continued)

(52) **U.S. Cl.**  
CPC ..... **H02J 3/383** (2013.01); **H02J 3/386** (2013.01); **H02J 3/387** (2013.01); **H02J 7/0052** (2013.01);  
(Continued)

(58) **Field of Classification Search**  
CPC .. H02J 3/383; H02J 3/386; H02J 3/387; H02J 7/0052; H02J 7/0068; H02M 3/285; H02M 3/3376; Y02E 10/76  
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Justin W. McCabe, Esq.; Shawn Gordon, Esq.; Dunkiel Saunders Elliott Raubvogel & Hand, PLLC

(57) **ABSTRACT**

A voltage booster allowing for increased utilization of low voltage, high current, unregulated DC power ("LVDC source"), such as, but not limited to, fuel cells, batteries, solar cells, wind turbines, and hydro-turbines. LVDC generation systems employing a variable low voltage DC-DC converter of the present disclosure may be used without a power inverter in applications requiring high voltage DC inputs and can also allow for the employment of common, low cost, reliable, low voltage energy storage chemistries (operating in the 12-48 VDC range) while continuing to employ the use of traditional inverters designed for high voltage power supplies. An embodiment of the DC boost converter includes a plurality of interleaved, isolated, full-bridge DC-DC converters arranged in a Delta-Wye configuration and a multi-leg bridge.

**16 Claims, 9 Drawing Sheets**

