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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/319,927	05/18/2023	Lorenzo Rossi	261553-528737	5402

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EXAMINER	
DIAZ, MIGUEL ANGEL	

ART UNIT	PAPER NUMBER
3763	

NOTIFICATION DATE	DELIVERY MODE
12/19/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 18/319,927	Applicant(s) Rossi et al.	
	Examiner MIGUEL A DIAZ	Art Unit 3763	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 5/18/2023.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-19 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-19 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 5/18/2023 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections – 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

Claims 16-19 are rejected under 35 U.S.C. 112(b) as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor regards as the invention.

Claim 16 contains the following issues:

- The claim recites "the modular multi-level converter" in line 6, without proper antecedent basis. It is unclear whether said modular multi-level converter pertains to the DC to AC converter, or some other structure. **For examination purposes**, "the modular multi-level converter" will be construed as –the DC to AC converter—.

The remaining claims are rejected at least by virtue of their dependency.

Claim Rejections - 35 USC § 102

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis (i.e., changing from AIA to pre-AIA) for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention.

Claims 1-5 and 12-15 are rejected under 35 U.S.C. 102(a) (1) as being anticipated by Cann (US 4306420 A).

As per claim 1, Cann discloses a heat pump system (**see fig. 1**) comprising: a plurality of compressors (**10, 20**) including a first compressor (**20**) and a second compressor (**10**); a plurality of heat exchangers (**32, 40, 50**) including a first heat exchanger (**40**), a second heat exchanger (**50**), and a third heat exchanger (**32**); a plurality of expansion devices (**42, 44, 60**) including a first expansion device (**60**), a second expansion device (**42**), and a third expansion device (**44**), wherein, when the system operates in a cascade heating mode (**i.e., when 40 is used as a condenser**), the third heat exchanger (**32**) is configured to: receive (**i.e., after cycling through the system**) a first portion of refrigerant from the first compressor (**20**) and a second portion of refrigerant from the second compressor (**10**), and provide a first consistent flow of refrigerant (**via 13, 17**) to the first compressor (**20**) and a second consistent flow of refrigerant (**via 11**) to the second compressor (**10**).

As per claim 2, Cann discloses wherein the third heat exchanger (**32**) includes a flash-tank-heat-exchanger (**i.e., by being an accumulator; see col. 3, line 18**).

As per claim 3, Cann discloses wherein the third heat exchanger (**32**) is configured to contain a mixture of liquid refrigerant and vapor refrigerant (**evident by its relative location in the circuit; i.e., at the vapor suction of the first compressor**).

As per claim 4, Cann discloses wherein before received by the third exchanger (**32**), the first portion of refrigerant passes through the first heat exchanger (**40**) and the third expansion device (**44; see at least col. 4, lines 13-17**).

As per claim 5, Cann discloses wherein the first heat exchanger (**40**) is located indoors (**col. 3, line 15**).

As per claim 12, Cann discloses wherein the first compressor (**20**) includes a high-pressure compressor (**col. 3, line 14**).

As per claim 13, Cann discloses wherein the second compressor (**10**) includes a low-pressure compressor (**col. 3, lines 13-14**).

As per claim 14, Cann discloses wherein the first compressor (**20**) and the second compressor (**10**) are in operation when the system operates in the cascade heating mode (**col. 3, lines 62-65 and col. 4, lines 13-18**).

As per claim 15, Cann discloses wherein when the system operates in a heating or a cooling mode, the first compressor (**20**) is in operation and the second compressor (**10**) is not in operation (**col. 4, lines 51-58**).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 6-11 are rejected under 35 U.S.C. 103 as being unpatentable over Cann (US 4306420 A) in view of Takegami et al. (US 20240027116 A1), herein Takegami.

As per claim 6, Cann may not appear to explicitly disclose wherein the third heat exchanger is configured to output a vapor portion of a mixture of the first portion and second portion of the refrigerant via a first output and a liquid portion of mixture of the first portion and second portion of the refrigerant via a second output.

On the other hand, Takegami, directed to a heat pump system, discloses wherein the third heat exchanger (**15**) is configured to output a vapor portion of a mixture of the first portion and second portion of the refrigerant via a first output (**37**) and a liquid portion of mixture of the first portion and second portion of the refrigerant via a second output (**o4**).

Furthermore, it has been held that some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention is a support for a conclusion of obviousness which is consistent with the proper "functional approach" to the determination of obviousness as laid down in Graham, if the following findings can be articulated: (1) a finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; (2) a finding that there was reasonable expectation of success; and (3) whatever additional findings based on the Graham factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.[1]

As per (1), Takegami discloses that the third heat exchanger (**receiver 15**) serves as a container to store refrigerant, wherein both gas and liquid refrigerant coexist (¶ **55**). The gas portion may be sent to the main compressor to supplement its capacity (¶ **59**), and the liquid portion may be sent to a subcooler (¶ **61**). As per (2), one of ordinary skill in the art would recognize that

[1] See MPEP § 2143.

since the prior art of Takegami has successfully implemented its own teachings with regards to the third heat exchanger, there would also be a reasonable expectation of success if said teachings were to be incorporated into the teachings of Cann. Said reasonable expectation of success is apparent from the fact that both Cann and Takegami are analogous to the claimed invention, at least by virtue of being within the same field of endeavor (i.e., heat pumps). Thus, one of ordinary skill in the art would recognize that the teachings of the prior art are compatible and combinable, without yielding unpredictable results. As per (3), one of ordinary skill in the art, when considering the aforementioned evidence, would comprehend that the prior art teachings of Cann may be significantly improved by incorporating the prior art teachings of Takegami, since the teachings thereof serve to complement the teachings of Cann by virtue of suggesting the supplementation of the refrigerating capacity by providing both gaseous refrigerant and liquid refrigerant to different portions of the circuit, as needed.

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have taken the teachings of Cann and to have modified them with the teachings of Takegami, by having the third heat exchanger configured to output a vapor portion of a mixture of the first portion and second portion of the refrigerant via a first output and a liquid portion of mixture of the first portion and second portion of the refrigerant via a second output, in order to provide supplemental refrigeration capacity to different parts of the system, as needed, as similarly suggested by Takegami, without yielding unpredictable results.

As per claim 7, Cann as modified discloses wherein the first output (**37 of Takegami**) of the third heat exchanger (**15 of Takegami**) is in fluid communication with an input of the first compressor (**21 of Takegami**) when the system operates in the cascade heating mode (**see ¶ 243 of Takegami**).

As per claim 8, Cann as modified discloses wherein the second output (**o4 of Takegami**) of the third heat exchanger (**15 of Takegami**) is in fluid communication with the second expansion device (**represented by 14 of Takegami**) when the system operates in the cascade heating mode (**see arrows in at least fig. 5 of Takegami**).

As per claim 9, Cann as modified discloses wherein the second expansion device (**42 of Cann**) is in fluid communication with the second heat exchanger (**50 of Cann**) when the system operates in the cascade heating mode (**evident from fig. 1 of Cann**).

As per claim 10, Cann as modified discloses wherein the second heat exchanger (**50 of Cann**) is in fluid communication with an input port (**11 of Cann**) of the second compressor (**10 of Cann**) when the system operates in the cascade heating mode (**evident from fig. 1 of Cann**).

As per claim 11, Cann as modified discloses wherein the second heat exchanger (**50 of Cann**) is located outdoors (**see col. 3, line 16 of Cann**).

Claims 16 and 18-19 are rejected under 35 U.S.C. 103 as being unpatentable over Cann (US 4306420 A) in view of Scheucher (US 7948207 B2).

As per claim 16, Cann discloses the heat pump system of claim 1 (**see rejection of claim 1**).

However, Cann may not appear to explicitly disclose a fuel cell unit; a backup battery unit including a battery management circuitry; a direct current (DC) to alternate current (AC) converter; and the heat pump system of the heat pump system of wherein the modular multi-level converter is configured to: receive direct current from the fuel cell or the backup battery unit; convert the direct current to alternate current; and supply the alternate current to the heat pump system of claim 1.

On the other hand, Scheucher, directed to a battery powered vehicle, discloses a fuel cell unit (**see at least col. 13, line 28**); a backup battery unit (**col. 14, lines 8-11**) including a battery management circuitry (**e.g., 500 and related components**); a direct current (DC) to alternate current (AC) converter (**col. 13, lines 43-45**); and wherein the DC to AC converter is configured to: receive direct current from the fuel cell or the backup battery unit (**see col. 2, lines 30-40; col. 8, lines 50-54; col. 13, lines 26-28**); convert the direct current to alternate current (**e.g., col. 13, lines 38-43**); and supply the alternate current to the heat pump system of claim 1 (**evident from the description of "other electrical functions" in col. 2, lines 30-40**).

Furthermore, it has been held that some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention is a support for a conclusion of obviousness which is consistent with the proper "functional approach" to the determination of obviousness as laid down in Graham, if the following findings can be articulated: (1) a finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; (2) a finding that there was reasonable expectation of success; and (3) whatever additional findings based on the Graham factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.[2]

As per (1), Scheucher teaches that their invention contemplates a highly modular, intelligent, and quick exchangeable battery system (**col. 3, lines 29-32**). Additionally, Scheucher contemplates additional advantages regarding energy efficiency and distributed intelligence that facilitates continuous battery monitoring of problems or failures (**col. 6, lines 38-47**). They also

[2] See MPEP § 2143.

recognize a major advantage in the modular design by enabling the servicing of the motherboard without interrupting the operation of the power supply system (**col. 24, lines 44-46**). As per (2), one of ordinary skill in the art would recognize that since the prior art of Scheucher has successfully implemented its own teachings with regards to the fuel cell and battery backup, there would also be a reasonable expectation of success if said teachings were to be incorporated into the teachings of Cann. Said reasonable expectation of success is apparent from the fact that both Cann and Scheucher are analogous to the claimed invention, at least by virtue of being within the same field of endeavor (i.e., heat pumps, fuel cells and battery backup systems). Thus, one of ordinary skill in the art would recognize that the teachings of the prior art are compatible and combinable, without yielding unpredictable results. As per (3), one of ordinary skill in the art, when considering the aforementioned evidence, would comprehend that the prior art teachings of Cann may be significantly improved by incorporating the prior art teachings of Scheucher, since the teachings thereof serve to complement the teachings of Cann by virtue of suggesting a modular power system with increased energy efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have taken the teachings of Cann and to have modified them with the teachings of Scheucher, by having a fuel cell unit; a backup battery unit including a battery management circuitry; a direct current (DC) to alternate current (AC) converter; and the heat pump system of the heat pump system of wherein the modular multi-level converter is configured to: receive direct current from the fuel cell or the backup battery unit; convert the direct current to alternate current; and supply the alternate current to the heat pump system of claim 1, in order to provide a modular power system with increased energy efficiency, as similarly suggested by Scheucher, without yielding unpredictable results.

As per claim 18, Cann as modified discloses wherein fuel cell unit includes a hydrogen storage tank (**i.e., the source of compressed hydrogen; see col. 2, line 38 of Scheucher**), a fuel cell (**col. 8, line 54 of Scheucher**), and a condenser (**either one of 40 or 50 of Cann during their respective condenser operation**).

As per claim 19, Cann as modified discloses wherein the battery management circuitry is configured to maintain the backup battery (**col. 6, lines 42-47 of Scheucher**).

Claim 17 is rejected under 35 U.S.C. 103 as being unpatentable over Cann (US 4306420 A) as modified by Scheucher (US 7948207 B2), as applied to claim 16 above, and further in view of Sharifzadeh et al. (US 20210344279 A1), herein Sharifzadeh.

As per claim 17, Cann as currently modified may not appear to explicitly disclose wherein the DC to AC converter includes a nine-level modular multi-level convert.

On the other hand, Sharifzadeh, directed to a multilevel electric power converter, discloses wherein the DC to AC converter includes a nine-level modular multi-level convert (**see at least ¶ 18**).

Furthermore, it has been held that some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention is a support for a conclusion of obviousness which is consistent with the proper "functional approach" to the determination of obviousness as laid down in Graham, if the following findings can be articulated: (1) a finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; (2) a finding that there was reasonable expectation of success; and (3)

whatever additional findings based on the Graham factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.[3]

As per (1), Sharifzadeh recognizes that a greater number of voltage levels can produce sinusoidal waveforms with improved accuracy (**see third-to-last sentence of ¶ 3**). Moreover, the greater number of voltage levels also produces waveforms with lower harmonic distortion (**see last sentence of ¶ 2**). As per (2), one of ordinary skill in the art would recognize that since the prior art of Sharifzadeh has successfully implemented its own teachings with regards to the voltage levels, there would also be a reasonable expectation of success if said teachings were to be incorporated into the teachings of Cann. Said reasonable expectation of success is apparent from the fact that both Cann and Sharifzadeh are analogous to the claimed invention, at least by virtue of being within the same field of endeavor (i.e., heat pumps and power management). Thus, one of ordinary skill in the art would recognize that the teachings of the prior art are compatible and combinable, without yielding unpredictable results. As per (3), one of ordinary skill in the art, when considering the aforementioned evidence, would comprehend that the prior art teachings of Cann may be significantly improved by incorporating the prior art teachings of Sharifzadeh, since the teachings thereof serve to complement the teachings of Cann by virtue of suggesting the production of waveforms with greater accuracy and lower harmonic distortion.

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have taken the teachings of Cann and to have modified them with the teachings of Sharifzadeh, by having the DC to AC converter include a nine-level modular multi-level convert, in order to provide waveforms with greater accuracy and lower harmonic distortion, as similarly suggested by Sharifzadeh, without yielding unpredictable results.

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[3] See MPEP § 2143.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MIGUEL A DIAZ whose telephone number is (313)446-6587. The examiner can normally be reached Monday - Friday: 9:00 AM - 5:00 PM Eastern Time.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jianying C. Atkisson can be reached on (571) 270-7740. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/MIGUEL A DIAZ/
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