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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/449,326	08/01/2014	Thomas Magesacher	INFAP394US	8499

51092 7590 10/14/2020

Eschweiler & Potashnik, LLC.
Rosetta Center
629 Euclid Ave., Suite 1000
Cleveland, OH 44114

EXAMINER
AHN, SUNG S

ART UNIT	PAPER NUMBER
2631	

NOTIFICATION DATE	DELIVERY MODE
10/14/2020	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte THOMAS MAGESACHER, PETER SINGERL, MARTIN MATALN, and CHRISTAIN SCHUBERTH

Appeal 2019-002849
Application 14/449,326
Technology Center 2600

Before JEAN R. HOMERE, CAROLYN D. THOMAS, and CARL W. WHITEHEAD JR., *Administrative Patent Judges*.

HOMERE, *Administrative Patent Judge*.

DECISION ON APPEAL

I. STATEMENT OF THE CASE[1]

Pursuant to 35 U.S.C. § 134(a), Appellant appeals from the Examiner's decision to reject claims 1–18 and 20–25, which constitute all of the pending claims.[2] Appeal Br. 4. The Examiner has objected to claim 19 as being dependent upon a rejected base claim, but would otherwise be allowable if rewritten in independent form to include the limitations of the

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[1] We refer to the Specification, filed Aug. 1, 2014 ("Spec."); the Final Office Action, mailed Jan. 24, 2018 ("Final Act."); the Appeal Brief, filed Sept. 24, 2018 ("Appeal Br"); the Examiner's Answer, mailed Jan. 24, 2019 ("Ans."); and the Reply Brief ("Reply Br.") filed Feb. 28, 2019.

[2] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42(a). Appellant identifies Infineon Technologies AG as the real party in interest. Appeal Br. 1.

base claim and any intervening claims. Final Act. 24. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

II. CLAIMED SUBJECT MATTER

According to Appellant, the claimed subject matter relates to a system for modifying input/output signals of digital pre/post distortion of non-linear components (e.g. use of power amplifier for wire/wireless communications) by modeling them with a segment-wise piecewise polynomial approximation to mitigate the unwanted effects resulting from out-of-bands emissions and in-band distortions components. Spec. ¶¶ 1, 19, 20. Figure 1 is discussed and reproduced below:

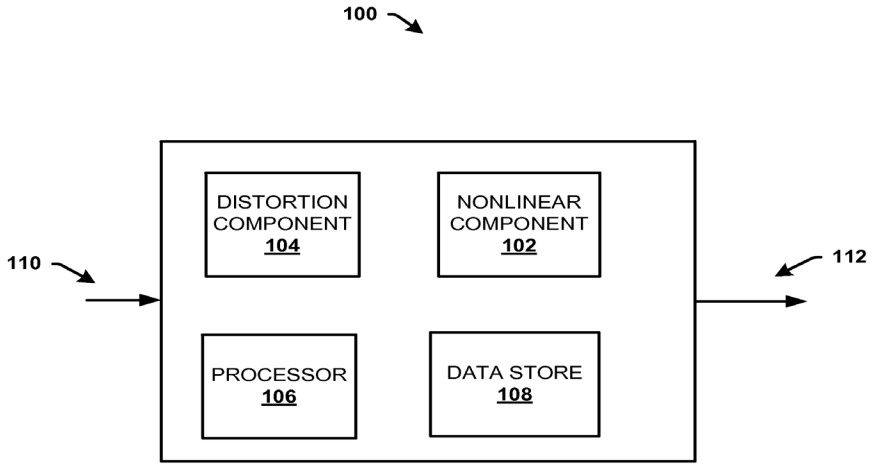

FIG. 1

Figure 1 illustrates non-linear system (100) including nonlinear component (102) for generating linear characteristics in output (112), which is improved by distortion component (104) to thereby reduce nonlinearity characteristics of the output signal and mitigate distortion thereof. Spec. ¶ 21.

As depicted in Figure 1 above, upon receiving input signal (110), nonlinear component (104) processes the input signal to generate a nonlinear output, and applies to a segment thereof a generated model of nonlinearity of nonlinear component based on a segment-wise piecewise polynomial approximation to decrease the nonlinearity of output (112). *Id.* ¶¶ 19–23.

Illustrative Claim

Claims 1, 13, and 20 are independent. Claim 1, reproduced below with disputed limitations emphasized, is illustrative:

> A nonlinear system for mitigating nonlinearity from a nonlinear behavior having memory or exhibiting a memory effect comprising:
>
> a memory storing executable components; and
>
> a processor, coupled to the memory, configured to execute or facilitate execution of the executable components, the executable components comprising:
>
> a nonlinear component configured to process an input and provide an output that comprises a nonlinearity;
>
> a distortion component configured to generate a model of the nonlinearity of the nonlinear component based on a segment-wise piecewise polynomial approximation and provide a model output that decreases the nonlinearity; and
>
> a distortion core component configured to *generate an approximation of the nonlinearity by applying the segment-wise piecewise polynomial approximation to a segment of the nonlinearity*.

Appeal Br. 10 (Claims Appendix).

III. REFERENCES

The Examiner relies upon the following references.[3]

[3] All reference citations are to the first named inventor only.

Name	Number	Publ'd/Issued
Jin	US 6,642,786 B1	Nov. 4, 2003
Singerl	US 2008/0032642 A1	Feb. 7, 2008
Jiang	US 2010/0253425 A1	Oct. 7, 2010
Azadet	US 2014/0314181 A1	Oct. 23, 2014

IV. REJECTIONS[4]

The Examiner rejects claims 1–18, and 20–25, as follows:

1. Claims 1–17, 20–23, and 25 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the combined teachings of Jiang, Azadet, and Singerl. Final Act. 5–21.
2. Claims 18 and 24 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the combined teachings of Jiang, Azadet, Singerl, and Jin. Final Act. 21–23.

V. ANALYSIS

We consider Appellant's arguments *seriatim*, as they are presented in, pages 3–8 of the Appeal Brief and pages 1–8 of the Reply Brief. We are unpersuaded by Appellant's contentions. Except as otherwise indicated herein below, we adopt as our own the findings and reasons set forth in the Final Action, and the Examiner's Answer in response to Appellant's Appeal Brief. Final Act. 2–25; Ans. 3–5. However, we highlight and address specific arguments and findings for emphasis as follows.

[4] The Examiner has objected to claim 19 as being dependent upon a rejected base claim, but would otherwise be allowable if rewritten in independent form to include the limitations of the base claim and any intervening claims. Final Act. 24.

Regarding the rejection of claim 1, Appellant argues, *inter alia*, that the combination of Jiang, Azadet, and Singerl does not teach or suggest applying a segment-wise piecewise polynomial approximation to a segment of the nonlinearity. Appeal Br. 3. In particular, Appellant argues the following:

> Jiang discloses a predistortion solution for the linearization of power amplifiers, especially with memory effects. (*See,* Abstract, first sentence). A predistorter signal is generated from an input signal (e.g., X_n) based on (P_{kq}), where P_{kq} a complex valued function of a single complex variable. (*See,* Abstract, second sentence). Further, where z, y are inputs and outputs of a PA, for every input Z_n there is a sequence y_n. Where Q is a length of the memory effect, a function of the output Z_n is based on a function P as a multivariate function with the Q variable. (*See,* para. [0011]). This multivariate function P can be approximated by a sum of separable functions, and each P_{kq} is a function of one complex variable (*see,* para. [0013]), where each P_{kq} can be computed using polynomials (*see,* para. [0014]). However, Jiang is silent with respect to applying a segmentwise piecewise polynomial approximation ***to*** **a segment** of the nonlinearity.

Id. at 4 (citing Jiang ¶¶ 11, 13, 14).

Therefore, Appellant argues that although Jiang discloses using coefficients of polynomials to an input signal X_n to generate a pre-distortion model for linearizing a power amplifier, and thereby teaches computing an approximation function y(t) using polynomials, Jiang does not teach applying a piecewise polynomial approximation to a segment of nonlinearity output function Y(t). *Id.* at 5–6 (citing Jiang ¶¶ 9–13). Further, Appellant argues that Jiang's disclosure of using a direct-approximation method consisting lookup tables (LUTs) to implement a P_{kq} function does not teach the disputed limitations either. *Id.* at 6 (citing Jiang ¶ 17). Furthermore, Appellant argues Azadet's disclosure of obtaining a LUT with polynomial

interpolation representing a nonlinear function with entries as polynomial coefficients for different segments teaches applying linear interpolation between segments to improve continuity of output segments, as opposed to applying a polynomial approximation to a segment of nonlinearity. *Id.* at 6–7 (citing Azadet ¶¶ 8, 21, 22, 38). According to Appellant, Azadet's evaluation of a polynomial for the LUT does not teach applying a polynomial approximation to a segment of the LUT. *Id.* at 7. Additionally, Appellant argues Singerl's disclosure of alleged improvement of the circuit design flexibility of pre-distortion does not cure the noted deficiencies. *Id.* at 7.

Appellant's arguments are not persuasive of Examiner error. Jiang discloses a pre-distorter that uses a piecewise polynomial to linearize the output of high power amplifier (HPA). (Jiang, Abstr., ¶¶ 3, 7, 17). Jiang alternatively discloses the pre-distorter using an algorithm for implementing memory polynomials by computing LUTs through a direct approximation method, which is more stable and accurate than the polynomials method. *Id.* ¶¶17, 20. We agree with the Examiner that Jiang's disclosed embodiment of the pre-distorter using a piecewise polynomial taken in combination with Jiang's disclosed alternative embodiment of using a polynomial approximation method to linearize the output of the HPA would have predictably resulted in a stable and accurate method for applying a segment-wise piecewise polynomial approximation to a segment of the nonlinearity. Ans. 4. We likewise agree with the Examiner that Azadet's disclosure of using a nonlinear modeling of a physical system using LUTs with polynomial interpolation cumulatively teaches the disputed limitations. *Id*. at 5 (citing Azadet ¶¶ 21, 22, Fig. 2).

Appellant's arguments in the Appeal Brief are tantamount to an individual attack against the distinct embodiments of Jiang, as opposed to the combination thereof relied upon by the Examiner in the rejection of claim 1. One cannot show non-obviousness by attacking the references or the embodiments thereof individually where the rejections are based on combined teachings of the references and/or embodiments. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986); *see also In re Keller*, 642 F.2d 413, 425 (CCPA 1981). We find the Examiner's proposed combination of the cited teachings of Jiang, Azadet, and Singerl is no more than a simple arrangement of old elements with each performing the same function it had been known to perform, yielding no more than what one would expect from such an arrangement. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). Therefore, the ordinarily skilled artisan, being "a person of ordinary creativity, not an automaton," would have been able to fit the teachings of the cited references together like pieces of a puzzle to predictably result in a stable and accurate method for applying a segment-wise piecewise polynomial approximation to a segment of the nonlinearity. *Id.* at 420–21. Because Appellant has not demonstrated that the Examiner's proffered combination would have been "uniquely challenging or difficult for one of ordinary skill in the art," we agree with the Examiner that the proposed modification would have been within the purview of the ordinarily skilled artisan. *See Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (citing *KSR*, 550 U.S. at 418). Consequently, we are satisfied that, on the record before us, the Examiner has established by a preponderance of the evidence that the combination of Jiang, Azadet, and Singerl teaches the disputed claim limitations. Because we are not

persuaded of Examiner error, we sustain the Examiner's rejection of claim 1 as being unpatentable over the combination of Jiang, Azadet, and Singerl.

Regarding the rejection of claims 2–18 and 20–25, Appellant has not presented separate patentability arguments or has reiterated substantially the same arguments as those previously discussed for the patentability of claim 1. As such, claims 2–18 and 20–25 fall therewith. *See* 37 C.F.R. § 41.37(c)(1)(iv).

VI. CONCLUSION

For the above reasons, we affirm the Examiner's rejections of claims 1–18 and 20–25.

VII. DECISION SUMMARY

In summary:

Claims Rejected	35 U.S.C. §	References s	Affirmed	Reversed
1–17, 20–23, 25	103	Jiang, Azadet, Singerl	1–17, 20–23, 25	
18, 24	103	Jiang, Azadet, Singerl, Jin	18, 24	
Overall Outcome			1–18, 20–25	

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED