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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/677,866	04/02/2015	Li Zhao	10885-013US1	6107

151672 7590 09/30/2020

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EXAMINER	
NIU, FENG	

ART UNIT	PAPER NUMBER
2669	

NOTIFICATION DATE	DELIVERY MODE
09/30/2020	ELECTRONIC

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte LI ZHAO and CRAIG H. MEYER

Appeal 2019-003944
Application 14/677,866
Technology Center 2600

Before CARL W. WHITEHEAD JR., DAVID M. KOHUT, and IRVIN E. BRANCH, *Administrative Patent Judges*.

BRANCH, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, and 48–52. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] We use "Appellant" to reference the applicant as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as "University of Virginia Patent Foundation." Appeal Br. 2.

STATEMENT OF THE CASE

Appellant's Invention

Appellant's invention "relates generally to MRI, and more particularly to systems and methods for tissue parameter (e.g., Tl, T2, T2*, perfusion parameters, diffusion parameters) mapping using an unscented Kalman filter ('UKF')." Spec. 4. Claim 1, reproduced below, is illustrative of argued subject matter.

> 1. A method for quantitative T2 mapping, comprising:
>
> acquiring, by a magnetic resonance imaging (MRI) system, undersampled k-space data associated with a physiological process in an area of interest of a subject, wherein the acquiring comprises acquiring the undersampled k-space data at a plurality of points over time at different respective locations in k-space;
>
> estimating, at each of the plurality of points over time, a T2 value directly from the undersampled k-space data, wherein the estimating comprises unscented Kalman filtering using a Kalman model in which the system state is defined by T2 and, as additional undersampled k-space data is added over time, the model converges to true T2 values; and
>
> generating, from the estimated T2 values and without image reconstruction, quantitative T2 parameter maps.

Appeal Br., Claims Appendix.

Rejections

Claims 1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, and 48–52 stand rejected under 35 U.S.C. § 112(b) as being indefinite in scope. Final Act. 4–6.

Claims 1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, and 48–52 stand rejected under 35 U.S.C. § 103 as being unpatentable over Sumpf

(Tilman J. Sumpf et al., *Model-based nonlinear inverse reconstruction for T2 mapping using highly undersampled spin-echo MRI*, 34 J. Magn. Reson. Imaging, 420–428, (2011)) and Shin (Jaemin Shin et al., *Correction for the T1 Effect Incorporating Flip Angle Estimated by Kalman Filter in Cardiac-Gated Functional MRI*, 70 Magn. Reson. Med., 1626–1633 (2013)). Final Act. 6–13.

35 U.S.C. § 112(b)

The Examiner finds each of the independent claims recites the same indefinite limitation (*see infra*). Final Act. 5. No further limitations are determined to be indefinite. *Id.* For the reasons below, we are persuaded of error in the Examiner's finding. We accordingly do not sustain the § 112(b) rejections.

Specifically, the Examiner finds each claim recites a UKF model that "converges to true T2 values," thereby "describes . . . [a] result or purpose or objective rather than a step or function performed by a step," and provides "no way to ascertain the scope of the invention by the desired results." Final Act. 5. The Examiner explains that the "converges to true T2 values" recitation is "an intended use similar to a desired result, purpose, or objective." Ans. 17 (internal quotation marks omitted).

Appellant contends:

> "[T]he model converge[nce] to true T2 values" describe[s] and clarif[ies] the use of the [UKF] model . . . for [the claimed] "acquiring . . . undersampled k-space data" . . . [and thereby] clarif[ies] and describe[s] the configuration of the specific [UKF] model being used in the claimed invention; the model is configured to "converge[] to true T2 values" with the addition of more undersampled k-space data.

Appeal Br. 7.

We are persuaded of error inasmuch the Examiner summarily concludes (i.e., without supporting reason, evidence, or case law) the claim language is indefinite if reciting an intended use. We cannot ascertain a Federal Circuit decision that equates intended use with indefiniteness.[2] *But compare In re Miller*, 441 F.2d 689, 693 (CCPA 1971) (Dismissing an allegation that "language was 'functional' and thus 'indefinite.'"). Moreover, as Appellant argues, no confusion results from the recited use of the UKF model; it simply states what the model does. Appeal Br. 7 (above block quote). Accordingly, for the above reasons, the Examiner has not shown an "uncertainty concerning what subject matter falls within the scope of the claims." *Miller*, 441 F.2d at 693 (summarizing the standard for indefiniteness).

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[2] *See*, for instructive non-binding decisions, *Promethean Insulation Tech. LLC v. Sealed Air Corp.*, No. 2:13-CV-1113-JRG-RSP, 2015 WL 1738028, at *23 (E.D. Tex. Apr. 6, 2015) ("[We] refuse [the] motion to declare claims indefinite[. The at-issue] language . . . is a non-limiting statement of intended use."), *order vacated in part on reconsideration*, No. 2:13-CV-1113-JRG-RSP, 2015 WL 11027035 (E.D. Tex. Aug. 11, 2015) (finding the at-issue language was not a non-limiting statement of intended use); *Ex Parte Douglas N. Breaux, Michael F. Cipriani, Richard C. Jaworski, Steven L. Martin, & Michael L. Williams*, No. 10/286,291, 2012 WL 5268528, at *2 (B.P.A.I. Oct. 18, 2012) ("[W]hile we agree that . . . intended use/functional language is usually subject to very broad constructions, such breadth is not indefiniteness."); *Ex Parte Hiroshi Akitomo & Tsugio Nozoe*, No. 08/061,406, 1995 WL 1718822, at *2 (B.P.A.I. 1995) ("['C]lay-like' as used in the claims is equivalent to a statement of intended use . . . and, as such, is not indefinite *per se*.").

35 U.S.C. § 103

Appellant presents two arguments (*see infra*) against the § 103 rejection of all claims. Appeal Br. 9–11. Appellant also presents a separate argument for dependent claims 5, 18, 31, and 44 (*see infra*). *Id.* at 12–14. We select claim 1 as representative of all but claims 5, 18, 31, and 44. 37 C.F.R. § 41.37(c)(1)(iv). We select claim 5 as representative of claims 5, 18, 31, and 44. *Id.* For the reasons below, we are not persuaded of error in the rejections of claims 1 and 5. We accordingly sustain all § 103 rejections.

Claim 1

First Argument:

The first argument concerns the claimed use of "T2 values." *See infra*. Appellant contends:

> [T]he final Office Action concedes that Sumpf does not disclose . . . a [UKF] model in which the system state is defined by T2. . . . [C]ontend[ing] that these deficiencies are cured by Shin[, t]he Examiner [concludes] . . . ["]a parameter like T1 (or T2) is best estimated . . . using a [UKF] model in which the system state is defined by T1 (or T2)[,] as disclosed by Shin[."] . . . [T]he portions of Shin cited by the Examiner . . . do[] not specifically disclose, teach, or suggest a system state defined by T2[.]

Appeal Br. 9–10 (emphasis omitted) (quoting Final Act. 8).

The Examiner responds:

> Shin has shown that T1 is best estimated with the [UKF] model in which the system state is defined by T1. Appellant has not disputed this fact. And, as is clear from Equation 2 of Sumpf, T2 is a relaxation time . . . similar to T1[,] which is a relaxation time. . . . Therefore, a parameter like T1 (or T2) is best estimated with the [UKF] model in which the system state is defined by T1 (or T2)[,] as laid out clearly in the rejection. . . .
>
> In response to applicant's arguments against [Shin]

> individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references.

Ans. 20–21 (internal quotation marks omitted).

We are not persuaded of error. The Examiner describes the combination of Sumpf and Shin as follows: Sumpf supplies a T2 parameter; Shin teaches a similar T1 parameter; and, in view of the similarity, it would have been obvious to use Sumpf's T2 parameter in manner similar to Shin's use of the T1 parameter. *Id.* The Appeal Brief does not address this reliance on Sumpf and Shin, but rather addresses only Shin. Appellant did not file a Reply Brief, much less respond to the Answer's above clarification of the rejection. Accordingly, Appellant's arguments do not persuasively rebut the rejection.

> Second Argument:
>
> Turning to the second argument, Appellant contends:
>
> > [W]ith respect to the . . . [claimed] use of [a] Kalman model[,] wherein "as additional undersampled k-space data is added over time, the model converges to true T2 values," the Examiner has improperly disregarded these features[as being indefinite.] . . . [T]he examiner should [nonetheless] consider the claim . . . [against the] prior art based on the examiner's [claim] interpretation.

Appeal Br. 10 (emphasis omitted) (citing Manual of Patent Examining Procedure (MPEP) §§ 707.07(g) and 2173.06).

The Examiner responds:

> As discussed . . . regarding [§] 112(b) rejection, . . . the result (i.e., "the model converges to true T2 values") is desired or implied[and, therefore,] "no further treatment on merit for this limitation . . . is necessary since the art rejection of other claim

> limitations . . . would imply the art rejection of this claim limitation."

Ans. 22 (emphases omitted). The Examiner's above-referenced § 112(a) discussion states:

> [T]he recited limitation in question is indeed an intended use similar to "a desired result, purpose, or objective".
>
> Appellant's argument actually raises a further question on whether or not the limitation in question . . . is implied by the other limitations in the claimed invention.
>
> [N]o further treatment on merit for this limitation . . . is necessary since the art rejection of other claim limitations . . . would imply the art rejection of this claim limitation.

Ans. 17–19 (emphases omitted).

We are unpersuaded of error. The Examiner finds the argued convergence of T2 values constitutes merely an intended use of the claimed UKF model; the combination of Sumpf and Shin achieves all other features of the claimed invention; and nothing further need be shown. *Id.*; *accord Minton v. Nat'l Ass'n of Sec. Dealers, Inc.*, 336 F.3d 1373, 1381 (Fed. Cir. 2003) (claim language held to be non-limiting because "it simply expresses the intended result of a process step positively recited"); *Tex. Instruments Inc. v. U.S. Int'l Trade Comm'n*, 988 F.2d 1165, 1172 (Fed. Cir. 1993) (claim language held to be non-limiting because it "merely describe[s] the result of arranging the components of the claims in the manner recited in the claims"). The Appeal Brief does not address the Examiner's determination that the argued feature is a non-limiting statement of intended use, but rather merely contends the claimed model is "configured to" converge to true T2 values—a naked allegation that the at-issue claim language is limiting and,

moreover, an inaccurate description of Appellant's claim language (which lacks "configured to" language). Appeal Br. 7. Appellant did not file a Reply Brief, much less respond to the Answer's above clarification of the rejection.

Claim 5

Claim 5 depends from claim 1 (indirectly) and recites: "wherein the measurement function comprises combining a noise value associated with the MRI system with a product of an undersampling pattern at a particular state, a Fourier transform operator, a coil sensitivity map associated with the MRI system, and a T2-weighted image at the particular state."

Appellant contends:

> The Examiner cites (without specific reference to elements, lines, etc.) across separate entire sections covered over 7 different pages of the two references (Sumpf at p. 421 and Shin at pp. 1627–1628 and 1630–1633).
>
> Moreover, there are distinctions between the recited features and the alleged corresponding sections cited by the Examiner. For example, the cited section of Sumpf on page 421 appears to describe using forward discrete Fourier transforms to synthesize "fully sampled k-space data", whereas [claim 5 incorporates claim 1's] use of undersampled k-space data; and, the cited section of Shin on pages 1627–28 appears to relate to T1 correction and does not relate to T2 values as encompassed in dependent claim 5. The cited sections also do not appear to disclose, teach, or suggest the "T2-weighted image" as recited in claim 5.
>
> Furthermore, none of the cited sections appears to disclose, teach, or suggest [claim 5's] "product of an undersampling pattern at a particular state, a Fourier transform operator, a coil sensitivity map associated with the MRI system, and a T2-weighted image at the particular state." . . . Further, . . . the Examiner fails to . . . [explain how] Sumpf as modified by Shin

[reaches] claim 5.

Appeal Br. 11–12 (emphases omitted) (addressing Final Act. 10).

The Examiner responds with the following lengthy clarification:

> First of all, "a product of an undersampling pattern at a particular state, a Fourier transform operator, a coil sensitivity map associated with the MRI system, and a T2-weighted image at the particular state" is clearly shown as P DFT $M_{TE}(x)$ in Equation 3 and/or P DFT ($M_{TE}(x)$ Cc) in Equation 5 of Sumpf. As disclosed by Sumpf, P "represents a multiplication with a binary sampling mask"[] (page 421, first paragraph in right column)[,] i.e., "an undersampling pattern at a particular state" as claimed. DFT (discrete Fourier transform) (see page 421, second to the last paragraph in left column) is "a Fourier transform operator" as claimed. $M_{TE}(x)$ (equation 2 on page 421) is "a T2-weighted image at the particular state" as claimed. Equation 5 includes "the sensitivity profiles Cc of the coil elements c" (page 421, last paragraph of right column) [,] which represents "a coil sensitivity map associated with the MRI system" as claimed. Equation 3 is a special case of Equation 5 for "a single receiver coil with uniform sensitivity" (i.e., Cc=1).
>
> Finally, "a noise value associated with the MRI system" is made obvious with the combination of Sumpf and Shin when S_{TE} (or P DFT ($M_{TE}(x)$ Cc) in Equations 3 and 5 of Sumpf is solved with the [UKF] model of Shin (see Equations 13–14 of Shin on page 1628), where V_k and W_k are "random gaussian state noise" (page 1628 of Shin). In particular, y_k in Equation 14 of Shin is a measured signal from fMRI measurements (page 1628 of Shin). When combining Sumpf with Shin, T1 estimation in Shin using the fMRI measurements is replaced with T2 estimation using MRI measurements in Sumpf. As a result, a noise value associated with the fMRI system (such as W_k in Shin) becomes a corresponding noise value associated with the MRI system of Sumpf.

Ans. 23–24 (emphasis omitted).

We are not persuaded of error. The Examiner's above clarification of the rejection is thorough and clear. Appellant did not file a Reply Brief, much less one responsive to the rejection as extensively clarified above. The argued claim features, set forth in the Appeal Brief, are fully addressed by the Examiner's above findings and the Appeal Brief is not responsive to the above findings. Appeal Br. 11–14.

DECISION SUMMARY

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, 48–52	112(b)	Indefiniteness		1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, 48–52
1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, 48–52	103	Sumpf, Shin	1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, 48–52	
Overall Outcome			1–7, 9–11, 15–20, 22–26, 28–33, 35–39, 41–46, 48–52	

TIME PERIOD FOR RESPONSE

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

AFFIRMED