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SCHIFF HARDIN, LLP - Chicago
PATENT DEPARTMENT
233 S. Wacker Drive-Suite 7100
CHICAGO, IL 60606-6473

EXAMINER
DALBO, MICHAEL J

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte HANS-PETER FAUTZ

Appeal 2019-000106
Application 14/326,661
Technology Center 2800

Before MELISSA A. HAAPALA, *Acting Vice Chief Administrative Patent Judge*, ALLEN R. MacDONALD and JASON M. REPKO, *Administrative Patent Judges*.

REPKO, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant[1] appeals under 35 U.S.C. § 134(a) from the Examiner's rejection of claims 1–9. App. Br. 4.[2] We have jurisdiction under 35 U.S.C. § 6(b). We reverse.

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[1] According to Appellant, the real party in interest is Siemens Aktiengesellschaft. App. Br. 1.

[2] Throughout this opinion, we refer to the Final Office Action ("Final Act."), mailed July 26, 2017; the Appeal Brief ("App. Br."), filed February 20, 2018; the Examiner's Answer ("Ans."), mailed August 3, 2018; and the Reply Brief ("Reply Br."), filed October 3, 2018.

THE INVENTION

Appellant's invention generally relates to magnetic resonance (MR) tomography. Spec. 1. An MR tomography device performs slice-imaging MR tomography. *Id.* These devices use reception coils to receive signals generated while scanning a subject. *Id.* The described invention optimizes the signal-to-noise ratio (SNR) from the reception coils. *Id.* at 3.

Claims 1, 8, and 9 are independent. Claim 8, reproduced below, is exemplary:

> 8. A magnetic resonance (MR) tomography apparatus comprising:
>
> an MR data acquisition unit comprising a radio frequency (RF) transmission system comprising a number n of single RF coils E_i with which reception signals I_i are respectively acquired, with i = 1, . . . , n;
>
> a processor provided with or configured to determine, for each single coil E_i, an individual reception sensitivity profile in the spatial domain r $B1_i^-(r)$:
>
> $$B1_i^-(r) = |a_i(r)| * e^{i \cdot \varphi_i(r)}$$
>
> with amplitude $a_i(r)$ and phase $\varphi_i(r)$;
>
> said processor being configured to operate the MR tomography apparatus to scan an examination subject introduced into the MR tomography apparatus to acquire reception signals $I_i(k)$ in the frequency domain with wave number k via the n reception coils E_i;
>
> said processor being configured to determine Fourier-transformed signals $IF_i(r)$ from the reception signals $I_i(k)$, wherein:
>
> $$IF_i(r) = \rho(r) \cdot e^{i\phi(r)} \cdot B1_i^-(r) + N$$
>
> with N:= noise term, $\rho(r)e^{i\phi(r)}$:= proton density;

said processor being configured to determine complexly corrected signals $\tilde{I}F_i(r)$ on the basis of the signals $IF_i(r)$ and the individual reception sensitivity profiles $B1_i^-(r)$;

said processor being configured to determine a sum signal $MR(r)$ via complex addition of the corrected signals $\tilde{I}F_i(r)$:

$$MR(r) = \sum_i \tilde{I}F_i(r)\,;\text{ and}$$

said processor being configured to reconstruct image data of the examination subject on the basis of the sum signal $MR(r)$, and to make the image data available at an output of the processor as an electronic data file.

Amendments to the Claims, filed May 12, 2017, p. 4.[3]

THE REJECTION

Claims 1–9 stand rejected under 35 U.S.C. § 101 as directed to patent-ineligible subject matter.[4] Final Act. 1–5.

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[3] The claim listing in the Appeal Brief was defective. *See* Notification of Non-Compliant Appeal Brief, Paper No. 20180309-1, mailed March 13, 2018. Appellant then filed a Supplemental Appeal Brief with a replacement claim listing. Supplemental Appeal Brief, filed April 6, 2018. But the replacement claim listing contains extraneous text. *See, e.g.*, *id.* at 5 (showing claim 1 with references to page and line numbers such as "(p.9, l.1-3)"). In this decision, we refer to the last-entered claims, which are the claims on appeal.

[4] We note that claim 1 uses italics inconsistently (e.g., claim 1 recites $a_i(r)$ and $a_i(r)$). Amendments to the Claims, filed May 12, 2017, p. 2. Also, several terms are italicized in claim 1 but not in its dependent claims. Claim 1 as originally filed does not contain the italicized versions of these terms, and we find no entered amendment that changes these terms. Claims, filed July 9, 2014. Thus, we treat all italicizations as typographical errors and, for example, interpret $a_i(r)$ and $a_i(r)$ as the same term.

ANALYSIS

I. Principles of Law

Section 101 defines patent-eligible subject matter as "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof." 35 U.S.C. § 101. But courts have long held that laws of nature, natural phenomena, and abstract ideas are not patentable. *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 70–71 (2012) (citing *Diamond v. Diehr*, 450 U.S. 175, 185 (1981)). These ineligible concepts are implicit exceptions to the statutory categories. *Id.* at 71.

The Supreme Court articulated a two-step subject-matter eligibility test in *Mayo* and *Alice Corp. v. CLS Bank International*, 573 U.S. 208 (2014). *Alice/Mayo* step one asks whether a claim is "directed to" a judicial exception. *Alice*, 573 U.S. at 217. In *Alice/Mayo* step two, we consider "the elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Id.* (quoting *Mayo*, 566 U.S. at 79, 78). Step two is described as a search for an "inventive concept." *Id.*

The USPTO recently published revised guidance on patent subject matter eligibility. 2019 Revised Patent Subject Matter Eligibility Guidance, 84 Fed. Reg. 50 (USPTO Jan. 7, 2019) ("Guidance"). Step 1 of the USPTO's eligibility analysis asks whether the claimed subject matter falls within the four statutory categories of invention. *Id.* at 53–54. Under Step 2A, Prong One of the Guidance, we determine if the claim recites a judicial exception, including particular groupings of abstract ideas (i.e.,

mathematical concepts, certain methods of organizing human activity, or mental processes). *Id.* at 52–53. If so, we then analyze the claim to determine whether the recited judicial exception is integrated into a practical application of that exception under Step 2A, Prong Two of the Guidance. *Id.* at 53–55; MPEP §§ 2106.05(a)–(c), (e)–(h) (9th ed. Rev. 08.2017, Jan. 2018). Only if the claim is directed to the judicial exception, do we then look to whether the claim adds a specific limitation beyond the judicial exception that is not "well-understood, routine, conventional activity in the field" (*see* MPEP § 2106.05(d)) or whether the claim simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exception. Guidance, 84 Fed. Reg. at 56.

II. The Examiner's Rejection and Appellant's Arguments

According to the Examiner, the claims are directed to an abstract idea. Final Act. 1. The Examiner determines that the claims are similar to abstract ideas relating to mathematical formulas and "collecting information, analyzing it, and displaying certain results of the collection and analysis." *Id.* at 3 (citing *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350 (Fed. Cir. 2016); *Digitech Image Techs., LLC v. Elecs. for Imaging, Inc.*, 758 F.3d 1344 (Fed. Cir. 2014); *Classen Immunotherapies, Inc. v. Biogen IDEC*, 659 F.3d 1057 (Fed. Cir. 2011); *In re Grams*, 888 F.2d 835 (Fed. Cir. 1989)). Also, the Examiner finds that the MR tomography apparatus is an additional element that is well-understood, routine, and conventional in the art. Ans. 4. According to the Examiner, the processor does not meaningfully limit the abstract idea beyond generally linking the method's use to a computer. *Id.*

The Examiner finds that the data collection and display are insignificant extra-solution activity. *Id.* at 6–8.

Appellant argues that the claims are patent eligible because they provide a technical solution to a problem in the field of MR tomography. App. Br. 6–7. In Appellant's view, a processor analyzes signals from the MR tomography device and its reception coils in a specific way. Reply Br. 2. Appellant points out that the "physical properties of those reception coils, namely the reception sensitivity profiles, are used in the analysis." *Id.*

III. Does the claim recite a judicial exception?

Under Step 2A, Prong One of the Guidance, we first consider whether the claim recites a judicial exception. Guidance, 84 Fed. Reg. at 51. The Guidance organizes the abstract-idea exception into the following subject-matter groupings: mathematical concepts, certain methods of organizing human activity (e.g., a fundamental economic practice), and mental processes. *Id.* at 52. The mathematical-concept grouping includes mathematical relationships, calculations, equations, and formulas. *Id.*

Here, the independent claims[5] recite three mathematical formulas:

(1) $B1_i^-(r) = |a_i(r)| * e^{i \cdot \varphi_i(r)}$,

(2) $IF_i(r) = \rho(r) \cdot e^{i\phi(r)} \cdot B1_i^-(r) + N$, and

[5] The three independent claims in this appeal recite substantially similar functions as a method (claim 1), an apparatus (claim 8), and a medium (claim 9). In particular, claim 8 recites an apparatus with a processor that performs the steps recited in claim 1's method. Likewise, claim 9 recites a computer-readable data-storage medium encoded with programming instructions causing a control and processing system to perform claim 1's method. We refer to claims 1, 8, and 9 collectively as the independent claims.

(3) $MR(r) = \sum_i \tilde{I}F_i(r)$.

The recited processor uses the first formula, $B1_i^-(r)$, for the individual reception-sensitivity profiles of the device's coil array. The MR tomography system then scans the examination subject to acquire frequency-domain signals, $IF_i(r)$. From these signals, the processor uses the second formula to determine the corresponding Fourier-transformed signals. Next, the processor determines the complexly corrected signals from the results of the first two formulas. Last, the processor sums the complexly corrected signals in the third formula to obtain sum signal $MR(r)$ for image reconstruction. In summary, the independent claims recite three mathematical formulas and four calculations that use those formulas.

The Examiner identifies these limitations as an abstract idea. Final Act. 2 (reproducing the limitations with bold formatting). As to this identified concept only, we conclude that, under Step 2A, Prong One of the Guidance, the independent claims recite an abstract idea: a mathematical concept.

IV. Is the claim directed to the recited judicial exception?

Because the claims recite an abstract idea, we now proceed to determine, under Step 2A, Prong Two of the Guidance, whether the recited judicial exception is integrated into a practical application. Guidance, 84 Fed. Reg. at 51. When a claim recites a judicial exception and fails to integrate the exception into a practical application, the claim is "directed to" the judicial exception. *Id.*

To the extent that the Examiner regards the MR tomography device's operation to be abstract, we disagree. *See* Final Act. 3 (discussing scanning an examination subject and reconstructing image data). As we explain in

our analysis below, the additional elements[6] reflect an improvement to a technology, and thus the independent claims integrate the recited mathematical concept into a practical application.

A claim may integrate the judicial exception into a practical application when, for example, it reflects an improvement to technology or a technical field. Guidance, 84 Fed. Reg. at 55 n.25 (citing MPEP § 2106.05(a)). For instance, the Federal Circuit found claims eligible when they were directed to a "particular configuration of inertial sensors and a particular method of using the raw data from the sensors," which improved the accuracy of calculating an object's position and orientation. *Thales Visionix, Inc. v. United States,* 850 F.3d 1343, 1349 (Fed. Cir. 2017), *cited in* MPEP § 2106.05(a)(II)(vii). Although the claims used mathematical equations, the Federal Circuit in *Thales* explained that "[t]he mathematical equations are a consequence of the arrangement of the sensors and the unconventional choice of reference frame in order to calculate position and orientation." *Id.* The claimed system eliminated "many 'complications' inherent in previous solutions" for determining an object's position and orientation. *Id.* at 1348.

On the other hand, a claim does not integrate the abstract idea into a practical application when it merely adds insignificant extra-solution activity or generally links the judicial exception's use to a particular technological environment or field. Guidance, 84 Fed. Reg. at 55 n.32 (citing MPEP § 2106.05(h)). For example, in *Parker v. Flook*, the claim used a

[6] We use the term "additional elements" for "claim features, limitations, and/or steps that are recited in the claim beyond the identified judicial exception." *See* Guidance, 84 Fed. Reg. at 55 n.24.

mathematical formula to calculate a numerical limit on a process variable in the catalytic chemical conversion of hydrocarbons. 437 U.S. 584, 586 (1978), *cited in* MPEP § 2106.05(h). The Supreme Court rejected the argument that the claim was made eligible through its limitations to the petrochemical field and oil refining. *Id.* at 589–91. Reflecting on this case, the Supreme Court in *Bilski v. Kappos* commented that "*Flook* established that limiting an abstract idea to one field of use or adding token postsolution components did not make the concept patentable." 561 U.S. 593, 612 (2010).

We disagree with the Examiner that the recited data collection is a field of use or merely adds token components to the mathematical equations. *See* Final Act. 3; Ans. 6–8. Here, as in *Thales*, the independent claims solve a technical problem. We agree with Appellant that the MR tomography device in the claimed solution is neither a token addition nor an abstract concept. App. Br. 6–7.

Specifically, the invention involves surface coils used in MR tomography. *See* Spec. 1–3. Modern MR tomography systems have both volume and surface coils. *Id.* at 1. Typically, volume coils act as a transmitter, and surface coils are "reception coils"—i.e., they receive signals generated during a scan of an examined subject. *Id.* Because the surface coils are flexible and small, they are particularly suited for imaging surface-proximate structures. *Id.* But surface coils have a small measurement depth and a reduced field of view. *Id.* Also, the coil's sensitivity decreases with distance. *Id.* at 2. So the surface coils have an inhomogeneous image exposure. *Id.* at 1–2. These properties may cause an undesirable intensity decline in the resulting image. *Id.* at 2.

Appellant is concerned with solving the technical problem of improving sensitivity correction in MR tomography devices. *See id.* at 3. Appellant's described solution overcomes the limitations of existing approaches. *See id.* at 2–4.

For example, one existing approach is the prescan-normalize method. *Id.* at 3. The prescan-normalize method creates a spatial-correction map using values from both the surface-coil array and the volume coil. *Id.* But this method cannot be used with high-field devices available at the time of the invention, because these devices lack a volume coil with a homogeneous reception sensitivity. *Id.* Unlike the prescan-normalize method, the claimed invention, as explained below, can be used in high-field systems because it does not use a volume coil as a reference. *Id.* at 6.

Another approach is the adaptive-combine method. *Id.* at 3. This method combines the reception coil's signals, but its SNR is sub-optimal. *Id.* The claimed invention, though, combines the signals in a way that optimizes SNR through the complex correction of the individual reception signals $I_i(k)$. *Id.* at 5.

Appellant's described technical solution is required by the independent claims. For instance, the independent claims recite determining each single coil's reception sensitivities, $B1_i^-(r)$, with the relative phases and amplitudes. This addresses the shortcomings of the prescan-normalize method, which does not determine the reception sensitivities of individual channels. *Id.* Also, the recited complex correction of the individual reception signals $I_i(k)$ allows the direct addition with optimal SNR. *Id.* This is an improvement over methods that combine measurement signals by calculating the absolute value, which prevents signal cancelations but does

not deliver optimal SNR. *Id.* at 3. The independent claims recite a practical application of these results because the claimed method, device, and medium improve the output by reconstructing "image data of the examination subject on the basis of the sum signal." *See* Claims 1, 8, and 9.

Here, as in *Thales*, "[t]hat a mathematical equation is required to complete the claimed method and system does not doom the claims to abstraction." 850 F.3d at 1349. The mathematical calculations recited in the independent claims are "a consequence of the arrangement of" the device's coils and how they receive signals during the scan. *See id.* For instance, Appellant points out that the reception coil's physical properties—i.e., the reception-sensitivity profiles—are used in the analysis. Reply Br. 2. This analysis results in an improved reconstructed image. *Id.* For all these reasons, the claimed invention uses the recited mathematical equations to improve the imaging system. *See id.*

Because we find the claims are not directed to an abstract idea, we need not proceed to determine whether the claims provide an inventive concept. *See* Guidance, 84 Fed. Reg. at 56 (discussing "*Step 2B: If the Claim Is Directed to a Judicial Exception, Evaluate Whether the Claim Provides an Inventive Concept*").

Thus, we do not sustain the rejection of independent claims 1, 8, and 9. For the same reasons, we also do not sustain the rejection of dependent claims 2–7, which are rejected under the same rationale. *See* Final Act. 4–5.

DECISION

We reverse the Examiner's decision to reject claims 1–9.

REVERSED