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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* DWIGHT E. NELSON, JIANPING WU, RAHUL GUPTA, and YAN ZHAO

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Appeal 2018-009013[1]
Application 13/955,367[2]
Technology Center 3700

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Before MURRIEL E. CRAWFORD, PHILIP J. HOFFMANN, and BRADLEY B. BAYAT, *Administrative Patent Judges.*

BAYAT, *Administrative Patent Judge.*

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's final rejection of claims 1–11, 13–23, and 25–53, which are all the claims pending in the Application. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] Our Decision references Appellant's Appeal Brief ("Appeal Br.," filed May 2, 2018) and Reply Brief ("Reply Br.," filed Sept. 20, 2018), the Examiner's Answer ("Answer," mailed July 26, 2018), and the Final Office Action ("Final Act.," mailed Dec. 5, 2017).

[2] Appellant identifies "Medtronic, Inc." as the real party in interest. Appeal Br. 3.

## THE INVENTION

Appellants' claims relate to determining a patient state based on activity of a bioelectrical brain signal of a patient in one or more frequency sub-bands of a frequency band of interest. Spec. ¶ 5. Claim 1, reproduced below with added bracketed matter, is illustrative of the claimed subject matter.

> 1. A method comprising:
>
> [(a)] receiving, with one or more processors, information representative of a bioelectrical brain signal of a patient;
>
> [(b)] selecting a frequency band of interest of the bioelectrical brain signal from a plurality of predetermined frequency bands, wherein the frequency band of interest is based on a patient condition, and wherein the predetermined frequency bands include two or more of a delta band, a theta band, an alpha band, a beta band, a gamma band, or a high gamma band;
>
> [(c)] selecting two or more frequency sub-bands of the frequency band of interest of the bioelectrical brain signal;
>
> [(d)] determining, with the one or more processors, activity of the bioelectrical brain signal within the selected two or more frequency sub-bands;
>
> [(e)] determining, with the one or more processors, a patient state based on activity of the bioelectrical brain signal within the selected two or more frequency sub-bands of the frequency band of interest of the bioelectrical brain signal;
>
> [(f)] generating, with the one or more processors, an indication of the determined patient state; and
>
> [(g)] controlling therapy delivery by a medical device to the patient based on the determined patient state.

## REJECTIONS

The Examiner rejected claims 1–7, 10, 11, 14–19, 22, 23, 26–38, 41–46, and 49–53 under 35 U.S.C. 103 as unpatentable over Denison et al. (US 2009/0082691 A1, pub. Mar. 26, 2009) ("Denison") and Sarkela (US 2007/0197930 A1, pub. Aug. 23, 2007).

The Examiner rejected claims 13 and 25 under 35 U.S.C. § 103 as unpatentable over Denison, Sarkela, and Official Notice.

The Examiner rejected claims 8, 9, 20, 21, 39, 40, 47, and 48 under 35 U.S.C. § 103 as unpatentable over Denison, Sarkela, and Navakatikyan (US 2008/0228100 A1, pub. Sept. 18, 2008).

## ANALYSIS

*Claims 1–4, 10, 11, 51, and 52*

The Examiner finds that Denison discloses substantially all the limitations of claim 1 except for "selecting two or more frequency sub-bands of the frequency band of interest of the bioelectrical brain signal and determining activity of the bioelectrical brain signal within the selected two or more frequency sub-bands," which the Examiner finds in Sarkela. Final Act. 3.

Appellants argue "Sarkela does not disclose or suggest that any sub-bands of an EEG signal are of interest." Appeal Br. 13.

We are unpersuaded of error by Appellants' argument. Sarkela discloses "brain wave signal data obtained from a subject is decomposed to obtain subband-specific output data for at least one subband of the original brain wave signal data, each subband corresponding to a specific type of epileptiform waveforms." Sarkela ¶ 21. Sarkela further discloses "Subband-specific entropy and kurtosis are both good indicators of epileptiform activity and may be used either alone or in combination to indicate epileptiform activity on the respective subband." *Id.* ¶ 22. According to Sarkela, "at least one EEG frequency band is selected . . . and the raw EEG signal data obtained from a patient is decomposed into at least one subband on which the waveforms of interest appear (steps **11** and **12**) so

as to obtain subband-specific output data for each of the at least one subband." *Id.* ¶ 41. Thus, Sarkela discloses selecting a sub-band of interest in order to obtain specific data of interest in various sub-bands.

Appellants argue the "Examiner has not shown that a person of ordinary skill in the art would have understood the specific frequency bands described by Denison to have contained epileptiform activity." Appeal Br. 13. We are not persuaded because Denison discloses that "a frequency selective monitor may be used for analysis relating to epilepsy," thus, at least suggesting a search for epileptiform activity using the monitor. Denison ¶ 52.

Appellants next argue Sarkela does not disclose that using two or more sub-bands of a selected frequency band would provide more *specific* epileptiform information, because the various sub-bands identified by Sarkela span more than one of the named frequency bands described in background. Appeal Br. 13–15 ("Sarkela fails to disclose or suggest that two or more frequency sub-bands of one of the described frequency bands may provide information that 'would improve the specificity of epileptiform activity . . . and . . . would allow the capability to detect specific types of epileptic patterns,' as asserted by the Examiner," because "the frequency sub bands described by Sarkela span more than one of the frequency bands described in paragraph [0004] of Sarkela.").

We are unpersuaded by Appellants' argument. We have no doubt that a narrower frequency range than an entire band is, by definition, more *specific*, leading to more specific information. However, as to whether one of ordinary skill would recognize using two sub-bands from within one frequency band from the disclosure of Sarkela, further analysis is necessary.

The Specification does not define what is meant by the claim terms "a delta band, a theta band, an alpha band, a beta band, a gamma band, or a high gamma band." However, these appear to be terms of art for at least EEG practitioners. The Specification further provides "[o]ne example of the frequency bands" in a chart. Spec. ¶ 33. The chart, for instance, shows an example "beta band" as being greater than 13 Hz but less than 35 Hz, and an example "gamma band" as being greater or equal to 35 Hz but less than 100 Hz. *Id.*

The prior art references disclose similarly named "bands," but with examples that have different frequency limits. In a treatment of "tracking alpha wave balance" as part of diagnosing depression or compulsive behavior, Denison discloses one example where "the monitored frequency bands may fall in the ranges of approximately 1 Hz or lower (delta band), 4 to 8 Hz (theta band), 5 to 15 Hz (alpha band), and 15 to 35 Hz (beta band)." Denison ¶ 51. Denison also discloses an example "gamma band" as being "30 to 80 Hz" (*id.* ¶ 59) and a "high gamma band" at 150 Hz to 200 Hz (*id.* ¶ 85). Sarkela discloses that the "EEG signal is often divided into four different frequency bands: Delta (0.5-3.5 Hz), Theta (3.5-7.0 Hz), Alpha (7.0-13.0 Hz), and Beta (13.0-32.0 Hz)." Sarkela ¶ 4. Thus, there is little precise agreement on the frequency range limits in these two prior art references and the Specification. The beta band, for example, may have a lower limit in the Specification, Denison, and Sarkela of 13 Hz or 15 Hz, and an upper limit of 32 or 35 Hz. The Gamma band examples are 30 Hz and 35 Hz as lower limits, and 80 Hz and 100 Hz as upper limits, in the Specification and Denison.

Further complicating the meaning of a sub-band, the Specification describes that a "frequency band, e.g., each of the frequency bands indicated

above, includes a plurality of frequency sub-bands, which are each defined by a narrower frequency band than the frequency band." Spec. ¶ 36 (cited at Appeal Br. 4). The Specification describes, in a permissive but non-limiting manner, that the "frequency band may be defined by a plurality of frequency sub-bands" (Spec. ¶ 7), but we discern no definition of "sub-band" in the Specification, other than that a sub-band is "narrower" than a band. A sub-band is not limited in the claims or Specification, for example, of lying entirely *within* the broader frequency range of a band, and the named frequency bands are not precisely limited in their ranges.

Therefore, Denison describes a beta band between 15 to 35 Hz (Denison ¶ 51), and Sarkela describes sub-bands of 16 to 32 Hz and 32 to 64 Hz (Sarkela ¶ 44). The first of these falls entirely within the beta band of Denison, and the second falls partly within the beta band of Denison (the portion from 32 to 35 Hz). Because the claims and Specification do not limit the ranges of frequency bands, and do not precisely limit a narrower sub-band to fall within one of the undefined frequency ranges of a frequency band, we broadly construe the claimed sub-bands to encompass Sarkela's example sub-bands, because 16 to 32 Hz and 32 to 35 Hz fall within Denison's example beta band range of 15 to 35 Hz, even though one of the example Sarkela bands extends beyond the example range in Denison, above 35 Hz.

Additionally, we discern nothing in Sarkela that limits the sub-bands each to be in a different named frequency band. For example, Sarkela discloses "at least one EEG frequency band is selected, which contains epileptiform activity (step **10**) and the raw EEG signal data obtained from a patient is decomposed into at least one subband on which the waveforms of interest appear." Sarkela ¶ 41. As such, Sarkela discloses the possibility of

selecting more than one sub-band of a selected EEG frequency band, thus meeting the claim language. Therefore, we are not persuaded that Sarkela does not meet the claim language because of disclosing additional sub-band examples where each selected sub-band is *not* restricted to being entirely within a single named frequency band.

We also are not persuaded that Sarkela fails to disclose selecting sub-bands of interest of a selected named frequency band of interest, because instead, according to Appellants, "what Sarkela actually describes is 'decompos[ing] brain wave signal data into at least one subband corresponding to waveforms of interest.'" Appeal Br. 14 (citing Sarkela ¶ 41). We interpret this argument to mean that selecting a waveform of interest is distinguishable from selecting a sub-band of interest. We are not convinced, however, because the Specification describes "determin[ing] a biomarker that indicates a power distribution of a bioelectrical brain signal based on a waveform generated from a plot of the power level versus frequency." Spec. ¶ 87 (cited at Appeal Br. 4). A waveform is thus one manner to gather information on signals within a band or sub-band of interest.

Appellants have thus not persuaded us of error on the part of the Examiner as to the obviousness rejection of claim 1. Consequently, we sustain the rejection of claim 1, as well as of dependent claims 2–4, 10, 11, 51, and 52, which were not argued separately. *See* Appeal Br. 16.

*Claim 5*

Claim 5 depends from claim 4, which recites "determining whether the bioelectrical brain signal includes a biomarker," and claim 5 recites "wherein the biomarker comprises a shift in a power distribution between the first frequency sub-band of the frequency band of interest and the second

frequency sub-band of the frequency band of interest over time." Appeal Br. 38, Claims App.

Appellants first argue reversible error as to the rejection of claim 5 because the Examiner relies on Denison, but, as argued with respect to claim 1, Denison does not disclose sub-bands. Appeal Br. 16. We are unpersuaded by this argument, because the Examiner does not solely rely on Denison to reject claim 5, but instead relies on the combination of Denison and Sarkela, wherein Sarkela was introduced for its disclosure of monitoring sub-bands.

Appellants also argue the "Examiner failed to connect the alleged disclosure of frequency sub-bands by Sarkela to the alleged disclosure of a biomarker described by Denison." *Id.* at 16–17. We are unpersuaded by Appellants' argument because in the rejection of claim 1 the Examiner articulates the reason for the combination of Denison and Sarkela. Final Act. 3.

*Claim 6*

Claim 6 depends from claim 4, which recites "determining whether the bioelectrical brain signal includes a biomarker," and claim 6 recites "wherein the biomarker comprises a change in a peak frequency within the selected two or more frequency sub-bands of the frequency band of interest." Appeal Br. 38, Claims App.

Appellants essentially argue the same two points advanced as to claim 5, that in the rejection of claim 1 Denison fails to disclose sub-bands, and that the Examiner has "failed to connect the alleged disclosure of frequency sub-bands by Sarkela to the alleged disclosure of a biomarker described by Denison." Appeal Br. 17–18. We find this argument unpersuasive for the same reasons discussed above for claim 5.

*Claim 7*

Claim 7 depends from claim 4, which recites "determining whether the bioelectrical brain signal includes a biomarker," and claim 7 recites "the biomarker comprises a predetermined characteristic of a distribution of a signal strength within the selected two or more frequency sub-bands of the frequency band of interest of the bioelectrical brain signal." Appeal Br. 39, Claims App.

Appellants basically argue the same two points advanced as to claim 5, that in the rejection of claim 1 Denison fails to disclose sub-bands, and that the Examiner has "failed to connect the alleged disclosure of frequency sub-bands by Sarkela to the alleged disclosure of a biomarker described by Denison." Appeal Br. 18–19. We find this argument unpersuasive for the same reasons discussed above for claim 5.

*Claim 13*

The Examiner rejected claim 13 as obvious over Denison, Sarkela, and Official Notice. Final Act. 5–6.

We are unpersuaded by Appellants' argument that the "Examiner's reliance on Official Notice as the sole basis to support the rejection of claim 13 is in error," on the basis that claim 19 includes the language of claim 1 (Appeal Br. 19), because the rejection is not based only on Official Notice.

We are also unpersuaded by Appellants' argument that the rejection should be reversed based on error in the rejection of claim 1 (Appeal Br. 19–20), because we find no error in the rejection of claim 1.

*Claims 14–16, 22, 23, and 53*

Appellants advance the same arguments presented for claim 1 for this group of claims. Appeal Br. 20–21. We find them unpersuasive for the same reasons discussed above for claim 1.

*Claims 17–19*

Appellants essentially repeat the arguments advanced for claims 5–7 for claims 17–19. Appeal Br. 21–24. We find them unpersuasive for the same reasons discussed above for claims 5–7.

*Claim 25*

Appellants essentially repeat the arguments advanced relative to claim 13 for claim 25. Appeal Br. 24–25. We find them unpersuasive for the same reasons discussed above for claim 13.

*Claims 26–29*

Appellants essentially repeat the arguments advanced relative to claim 1 for this group of claims. Appeal Br. 25–26. We find them unpersuasive for the same reasons as we did for claim 1.

*Claims 30–32*

Appellants repeat the arguments advanced relative to claim 1 for claims 30–32. Appeal Br. 26. We find them unpersuasive for the same reasons as claim 1.

*Claims 33–35*

Appellants repeat the arguments advanced relative to claim 1 for this group of claims. Appeal Br. 26–27. We find them unpersuasive for the same reasons as we did for claim 1.

*Claims 36–38*

Appellants essentially repeat the arguments advanced relative to claims 5–7 for these claims. Appeal Br. 27–30. We find them unpersuasive for the same reasons as for claims 5–7.

*Claims 41–43*

Appellants merely reference the arguments advanced for claim 1 and assert that they apply equally to independent claim 41. Appeal Br. 30–31. We find these arguments unpersuasive for the same reasons as for claim 1.

*Claims 44–46*

Appellants essentially reference the arguments advanced for claims 5–7 and assert they apply equally to claims 44–46. Appeal Br. 31–33. We find these arguments unpersuasive for the same reasons as for claims 5–7.

*Claims 49–50*

Appellants merely reference the arguments advanced for claim 1 and assert that they apply equally to independent claims 49 and 50. Appeal Br. 33–34. We find these arguments unpersuasive for the same reasons as for claim 1.

*Claims 8, 20, 39, and 47*

Appellants assert that Navakatikyan fails to overcome deficiencies in the rejection of claim 1 over Denison and Sarkela. Appeal Br. 34–35. We are unpersuaded of error on the part of the Examiner, because we are not persuaded of any shortcomings in the rejection of claim 1.

*Claims 9, 21, 40, and 48*

Each of dependent claims 9, 21, 40, and 48 recites language substantially equivalent to "wherein the biomarker comprises a width or a variability of the two or more frequency sub-bands exhibiting a relatively high or low level of activity." *See* Appeal Br., Claims App.

In rejecting these claims, the Examiner finds:

> Navakatikyan[] teaches determining a patient state (seizure) by identifying a biomarker comprising a unimodal peak or a bimodal peak, wherein determining the biomarker further comprises identifying whether a variability in the amplitude (unimodal peak) of one or more frequency sub-bands exhibits a relatively high or low level of activity (page 3, sections [0076-0082]).

Final Act. 6; *see also* Answer 10.

Appellants argue "the cited portions of Navakatikyan appear to fail to mention a width or variability of two or more frequency sub-bands of a frequency band of interest, much less looking at frequency sub-bands of a frequency band of interest." Appeal Br. 35–36. We are not persuaded. In order to construe the meaning of the "variability" language, we turn to the Specification, which does not define or limit the "variability" term. Instead, the Specification offers an example that the variability is in the width: "variability (e.g., in the width)." Spec. ¶¶ 6, 40, 83, 149. However, an example is not a definition. We, thus, construe "variability" broadly, to include variation in any parameter. Navakatikyan discloses looking for similarities and differences in "time interval." Navakatikyan ¶ 79. Time interval differences are a type of variation within the scope of these claims.

## DECISION

The Examiner's rejections of claims 1–11, 13–23, and 25–53 under 35 U.S.C. § 103 are AFFIRMED.

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

AFFIRMED