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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/936,964	11/10/2015	Yoshifumi TAKAHARA	2015-1461	4905

513 7590 11/07/2019

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ART UNIT	PAPER NUMBER
1795	

NOTIFICATION DATE	DELIVERY MODE
11/07/2019	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte YOSHIFUMI TAKAHARA, TAKAHIRO NAKAMINAMI, and SHIN IKEDA

Appeal 2019-001207
Application 14/936,964
Technology Center 1700

Before LINDA M. GAUDETTE, MONTÉ T. SQUIRE, and JANE E. INGLESE, *Administrative Patent Judges.*

GAUDETTE, *Administrative Patent Judge.*

DECISION ON APPEAL[1]

The Appellant[2] appeals under 35 U.S.C. § 134(a) from the Examiner's decision finally rejecting claims 15, 19, 20, and 22–25.[3]

We AFFIRM.

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[1] This Decision includes citations to the following documents: Specification filed Nov. 10, 2015 ("Spec."); Final Office Action dated Mar. 2, 2018 ("Final"); Appeal Brief filed July 18, 2018 ("Appeal Br."); Examiner's Answer dated Oct. 18, 2018 ("Ans."); and Reply Brief filed Nov. 26, 2018 ("Reply Br.").

[2] We use the word "Appellant" to refer to the "Applicant" as defined in 37 C.F.R. § 1.42(a). The Appellant identifies the real party in interest as PHC Holdings Corporation of Tokyo, Japan. Appeal Br. 2.

[3] We have jurisdiction under 35 U.S.C. § 6(b).

CLAIMED SUBJECT MATTER

The invention relates to a sensor for detecting or quantifying a target substance in a liquid sample, Spec. ¶ 1, such as blood glucose level, *id.* ¶ 125. Claim 15, reproduced below, is illustrative of the claimed subject matter:

> 15. A sensor for detecting or quantifying a target substance contained in a liquid sample including blood, comprising:
>
> a working electrode;
>
> a counter electrode;
>
> a quinone compound having quinone and at least one hydrophilic substituent;
>
> a coenzyme-dependent enzyme dehydrogenating or oxidizing the target substance; and
>
> a reagent layer including the coenzyme-dependent enzyme and the quinone compound,
>
> wherein the reagent layer is disposed so as to be in direct physical contact with the working electrode and/or the counter electrode,
>
> the oxidation-reduction potential of the quinone compound measured using a silver/silver chloride (saturated potassium chloride) electrode as a reference electrode is less than 0, is greater than oxidation reduction potential of the coenzyme, and is smaller than oxidation reduction potential of ascorbic acid,
>
> the quinone compound has a hydrophilic functional group,
>
> the coenzyme-dependent enzyme is a PQQ-dependent, an FAD-dependent, or an NAD-dependent enzyme, and
>
> the quinone is a phenanthrenequinone.

Appeal Br. 9 (Claims Appendix).

REFERENCES

The Examiner relies on the following prior art as evidence of unpatentability:

Pollmann	US 5,288,636	Feb. 22, 1994
Knappe	US 2008/0213808 A1	Sept. 4, 2008

Lapenaite et al., *Some quinone derivatives as redox mediators for PQQ-dependent glucose dehydrogenase*, Biologija, No. 1, 2004, pp. 20–22; hereinafter ("Lapenaite").

Louis Frederick Fieser, *The Reduction Potentials of Various Phenanthrenequinones*, Journal of the American Chemical Society, Vol. 51, No. 10, 1929, pp. 3101–3111; hereinafter ("Fieser").

REJECTION

Claims 15, 19, 20, and 22–25 are rejected under 35 U.S.C. § 103(a) as unpatentable over Pollmann in view of Lapenaite, Fieser, and Knappe.

OPINION

The Examiner found that Pollman discloses a sensor as recited in claim 15, with the exception of a quinone compound. *See* Final 5–6. More specifically, the Examiner found that Pollmann discloses a biosensor comprising a reagent layer in direct physical contact with working and counter electrodes. Final 5 (citing Pollmann Abstract, Figure 2). The Examiner found that the reagent layer comprises the oxidized form of a redox mediator, an enzyme, and a buffer. *Id.* (citing Pollmann 4:3–4, Table 1). The Examiner found that the enzyme may be a PQQ-dependent enzyme or an FAD-dependent enzyme, e.g., glucose dehydrogenase. *Id.* at 5–6 (citing Pollmann Table 1). The Examiner found that Pollmann teaches that "the mediator is chosen from ferricyanide, phenazine compounds, and . . .

benzoquinone compounds," but does not disclose explicitly that the mediator is a quinone compound having at least one hydrophilic substituent and the oxidation-reduction potential recited in claim 15. *Id.* at 6 (citing Pollmann, Table 1). However, as further discussed below, the Examiner determined that one of ordinary skill in the art would have used a quinone compound having the features recited in claim 15 as Pollmann's mediator based on the combined teachings of Lapenaite, Fieser, and Knappe. *See* Final 6–8.

Lapenaite discloses that 9,10-phenanthrenequinone is a suitable redox mediator for PQQ-dependent glucose dehydrogenase. Lapenaite Abstract, 21 (Table); *see* Final 6. The Examiner found that Lapenaite's disclosure would have suggested the use of a 9,10-phenanthrenequinone as the mediator in Pollmann (*see* Final 6–7; Ans. 3) which, as noted above, discloses the use of a reagent comprising glucose dehydrogenase (*see* Pollmann Table 1).

Knappe discloses mediators for use in detecting an analyte in a sample. Knappe ¶ 2, code (54). The sample may be whole blood, plasma, or serum, and the analyte may be glucose. *Id.* ¶¶ 12–13. Knappe discloses an embodiment wherein "the mediator comprises a phenanthrenequinone, a phenanthrolinequinone or a benzo[h]quinolinequinone." *Id.* ¶ 27; *see* Final 7. Knappe discloses that "substituents typically comprise groups which increase the solubility of the mediator in the sample to be investigated, such as, for example, quaternary amino groups, COOH and SO_3H." Knappe ¶ 37; *see* Final 7. Fieser discloses the reduction potentials of substituted 9,10-phenanthrenequinone compounds, including 9,10-phenanthrenequinone-1-sulfonic acid, 9,10-phenanthrenequinone-2-sulfonic acid, and 9,10-phenanthrenequinone-3-sulfonic acid. Fieser 3105 (Table III); *see* Final 7. The Examiner found that one of ordinary skill in the art would have

incorporated a sulfonic acid substitutent on the 9,10-phenanthrenequinone mediator in the Pollmann-Lapenaite sensor in order to increase the aqueous solubility of the mediator, as taught by Knappe. Final 8 (citing Knappe ¶ 37). The Examiner further found that the ordinary artisan would have utilized one of the listed compounds described in Fieser, i.e., 9,10-phenanthrenequinone-1-sulfonic acid, 9,10-phenanthrenequinone-2-sulfonic acid, or 9,10-phenanthrenequinone-3-sulfonic acid. *Id.* at 7–8. The Examiner notes that these compounds are among the compounds identified in claim 23—indirectly dependent from claim 15—as meeting the oxidation-reduction potential requirements recited in claim 15. Ans. 5; *see* Appeal Br. 10 (Claims Appendix).

The Appellant argues "that the combination of Pollmann, Lapenaite, Fieser, and Knappe fails to disclose or suggest the criterion for selecting phenanthrenequinone derivatives suitable for electrochemical sensors or indicate motivation to make such selection, as recited in independent claim 15," Appeal Br. 5, i.e., "a phenanthrenequinone that can be measured without being affected by ascorbic acid," Reply Br. 2. The Appellant thus contends the Examiner's obviousness determination is based on improper hindsight reasoning. *Id.* at 3.

The Appellant's argument is not persuasive because it fails to identify reversible error in the Examiner's fact finding and reasoning. A reference's teachings and its obvious variants are relevant prior art, even if the reference addresses a problem which differs from that addressed by a patent applicant. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1259 (Fed. Cir. 2007); *see also KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 420 (2007) (stating that it is error to look "only to the problem the patentee was trying to solve").

As found by the Examiner, *see* Final 6, Lapenaite describes 9,10-phenanthrenequinone as one of a limited number of suitable redox mediators for PQQ-dependent glucose dehydrogenase, *see* Lapenaite 21 (Table), which Pollmann explicitly describes as an enzyme component in a reagent for measuring the glucose level in a sample of human whole blood, *see* Pollmann 6:26–29, Table 1. The Examiner found that one of ordinary skill in the art would have incorporated a sulfonic acid substituent on the 9,10-phenanthrenequinone mediator in order to increase the aqueous solubility of the mediator, as taught by Knappe. Final 8. The Appellant has not explained why these findings are erroneous or unreasonable. Lapenaite discloses that the oxidation-reduction potential of 9,10-phenanthrenequinone as measured using a silver/silver chloride reference electrode, is -0.24. Lapenaite 21 (Table). Fieser discloses that "[i]n the case of the sulfonic acid group the influence on the potential is so slight that the effect of the position of the substituent may well be masked," Feiser 3108, and explicitly discloses three 9,10-phenanthrenequinones having sulfonic acid groups, *see id.* at 3105, that are identified in the Appellant's claim 23 as meeting the oxidation-reduction potential requirements recited in claim 15, *see* Appeal Br. 10 (Claims Appendix). Thus, contrary to the Appellant's contention, *see* Appeal Br. 5, the Examiner had a reasonable basis for finding that the ordinary artisan would have expected a 9,10-phenanthrenequinone having a sulfonic acid substituent to have an oxidation-reduction potential similar to that of 9,10-phenanthrenequinone, as well as the advantage of increased aqueous solubility, *see* Final 8. *See In re Kubin*, 561 F.3d 1351, 1357 (Fed. Cir. 2009) ("Even if no prior art of record explicitly discusses the . . . [limitation], [Appellant's] application itself instructs that [the limitation] is

not an additional requirement imposed by the claims on the [claimed invention], but rather a property necessarily present in [the claimed invention].").

The Appellant does not raise separate arguments in support of patentability of any dependent claims and does not identify evidence of unexpected results. Accordingly, we sustain the rejection of claims 15, 19, 20, and 22–25 for the reasons stated above, in the Final Office Action, and in the Answer.

CONCLUSION

Claims Rejected	35 U.S.C. §	References/Basis	Affirmed	Reversed
15, 19, 20, 22–25	103(a)	Pollmann, Lapenaite, Fieser, Knappe	15, 19, 20, 22–25	

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)(iv).

AFFIRMED