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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE
THE PATENT TRIAL AND APPEAL BOARD

Ex parte JAMES VAUGHAN HARSHMAN¹

Appeal 2019-001685
Application 14/932,721
Technology Center 1700

Before ROMULO H. DELMENDO, MARK NAGUMO, and
GEORGE C. BEST, *Administrative Patent Judges*.

NAGUMO, *Administrative Patent Judge*.

DECISION ON APPEAL

Evoqua Water Technologies LLC (“Harshman”) timely appeals under 35 U.S.C. § 134(a) from the Final Rejection² of all pending claims 14, 18, 22, 30–37, and 42–49. We have jurisdiction. 35 U.S.C. § 6 (2012). We reverse for reasons well-stated by Harshman.

¹ The applicant under 37 C.F.R. § 1.46 (Application Data Sheet, filed 04 November 2015), and hence the appellant under 35 U.S.C. § 134, is the real party in interest, identified as Evoqua Water Technologies LLC. (Appeal Brief, filed 21 September 2018 (“Br.”), 3.)

² Office Action mailed 25 April 2018 (“Final Rejection”; cited as “FR”).

OPINION

A. Introduction^{3, 4}

The subject matter on appeal relates to the treatment of air streams to remove offensive odiferous compounds, in particular hydrogen sulfide, H₂S, by treatment with a biotrickling filter. (Spec. 2, ll. 2–10, 18–19.) The biotrickling filter comprises a media bed that supports and maintains a population of H₂S-oxidizing bacteria. Treatment water is sprayed on the top of the media, and the water trickles through the media down to a sump as an effluent. At least some of the effluent is recirculated. H₂S-laden air is circulated through the moist filter bed, and the bacteria oxidize the H₂S to sulfuric acid, H₂SO₄, which lowers the pH of the biofilter bed. Recirculation of the effluent, dilution with make-up water, and treatment with alkaline water sprayed over the bed is said to “facilitate[] stabilization and maintenance of the pH of the biofilter bed at a level conducive for the bacteria to thrive.” (*Id.* at 10, ll. 5–7.) The amount of treatment necessary

³ Application 14/932,721, *Addition of alkaline materials to biotrickling filter or bio-filter make-up water*, filed 04 November 2015

as a continuation-in-part of 14/920,407, filed 22 October 2015, now U.S. Patent No. 10,159,932, which claims benefit of 62/084,007, filed 25 November 2014, and is a continuation-in-part of 14/270,461, filed 06 May 2014, now abandoned;

and as a continuation-in-part of 14/523,303, filed 24 October 2014, now U.S. Patent No. 9,586,176, which claims benefit of 61/895,645, filed 25 October 2013;

and as a continuation-in-part of 14/270,461, filed 06 May 2014, now abandoned and claiming the benefit of 62/078,632, filed 12 November 2014.

⁴ We refer to the “721 Specification,” which we cite as “Spec.”

varies with, e.g., the load on the sewage system, and dynamic control is said to be desirable to optimize control of pH and use of water. (*Id.* at para. bridging 14–15.)

Harshman seeks patent protection for a treatment method in which the pH is maintained by a “fuzzy logic” controller that takes, as input, the “error value,” that is, the difference between a target pH and the measured pH, and the time-rate-of-change of the error value, also known as the “error-dot value.” Rather than using “crisp” inputs, i.e., “actual measured inputs having defined values” (Spec. at 30, ll. 4–5), a membership function is used to define the degree to which a measurement belongs to a given fuzzy set. For example, for the error input, three fuzzy sets may be defined, namely, pH_low, pH_high, or pH_Good. (Spec. 31, ll. 1–4.) For the error-dot input, two fuzzy sets may be defined, namely, pH_getting_lower (positive error-dot) or pH_getting_higher (negative error-dot). (*Id.* at 32, Table 2). The system designer determines the number of possible actions, i.e., the number of fuzzy output value sets, and defines Rules to correspond to each fuzzy output set. (e.g., Spec. 33, Table 3, reproduced below.)

TABLE 3: Rules

Input Fuzzy Set Antecedent condition. If...	Output Set Consequent Action. Then...
pH_Good	Do_Nothing
pH_High	Close_fast
pH_Low	Open_fast
pH_Good AND getting_lower	Open_slow
pH_Good AND getting_higher	Close_slow

{Table 3 shows rules for actions based on input values }

A fuzzy logic system is said to be “inherently robust since it does not require precise, noise-free inputs” (*id.* at 28, ll. 19–20), and to be readily modified because “the fuzzy logic controller processes user-defined rules governing the target control system” (*id.* at ll. 22–23).

Sole independent claim 14 is representative and reads:

A method of removing hydrogen sulfide from contaminated air, the method comprising:

flowing the contaminated air through a biotrickling filter including

a media bed and

a population of hydrogen sulfide oxidizing bacteria disposed on media in the media bed,

the population of bacteria oxidizing hydrogen sulfide in the contaminated air into sulfuric acid;

introducing water from a source of water into the biotrickling filter;

measuring a pH of water having passed through the media bed;

maintaining the pH of the water having passed through the media bed within a predetermined range below about 4 by:

adding an alkaline material to the biotrickling filter;
and

*controlling an amount of one of
the alkaline material added to the biotrickling filter
per unit time and*

*an amount of the water added to the biotrickling
filter per unit time*

utilizing a fuzzy logic algorithm performed on a fuzzy logic-based controller,

the fuzzy logic algorithm using
a difference between the pH of the water having
passed through the media bed and a
predetermined pH setpoint (an error value) and
a change in pH of the water having passed
through the media bed per unit time (an error-
dot value)
as sole input parameters,
the fuzzy logic algorithm having
a total of five rules and
a total of five fuzzy output sets
to determine an output used to control
the amount of the one of the alkaline material
added to the biotrickling filter per unit time and
the amount of the water added to the
biotrickling filter per unit time; and
providing sufficient water from the source of
water to the media bed to rinse salts
produced by reaction between the alkaline
material and the sulfuric acid from the media
bed to prevent clogging of the media bed.

(Claims App., Br. 11; some formatting, and emphasis added.)

The Examiner enters the following new grounds of rejection:^{5, 6, 7}

- A. Claims 14, 18, 22, 30–34, 43, 44, and 46–49 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Parker,⁸ Turschmid,⁹ Reznik,¹⁰ and Khan.¹¹
- A1. Claim 35 stands rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Parker, Turschmid, Reznik, Khan, and Amir.¹²
- A2. Claim 36 stands rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Parker, Turschmid, Reznik, Khan, and Osterwald.¹³

⁵ Examiner’s Answer mailed 09 November 2018 (“Ans.”).

⁶ Because this application was filed after 16 March 2013, the effective date of the America Invents Act, we refer to the AIA version of the statute.

⁷ The Examiner adds the reference Reznik and denominates the rejection as a new ground of rejection. The text of the Answer mailed 09 November appears to be identical to the text of the Answer mailed 02 November, but for the initials of a third conferee.

⁸ Richard D. Parker et al., *Biological scrubber odor control system and method*, U.S. Patent Application Publication 2007/0180802 A1 (2007).

⁹ Krzysztof H. Turschmid et al., *Method for scrubbing gaseous emissions using bacteria*, U.S. Patent No. 6,013,512 (2000).

¹⁰ Leonid Reznik et al., *PID plus fuzzy controller structures as a design base for industrial applications*, 13 *Engineering Applications of Artificial Intelligence*, 419-430 (2000).

¹¹ Asim Ali Khan et al., *Fuzzy PID controller: design, tuning and comparison with conventional PID controller*, 2006 IEEE International Conference on Engineering of Intelligent Systems, Islamabad, 1–6 (2006).

¹² David Amir et al., *Wastewater treatment*, U.S. Patent Application Publication 2008/0308493 A1 (2008).

¹³ Mark Osterwald et al., *Method and conditioning system for regenerating replacement filters*, U.S. Patent No. 5,833,766 (1998).

- A3. Claim 37 stands rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Parker, Turschmid, Reznik, Khan, and Scheufler.¹⁴
- A4. Claim 42 stands rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Parker, Turschmid, Reznik, Khan, and Carnahan.¹⁵
- A5. Claim 45 stands rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Parker, Turschmid, Reznik, Khan, and Livingstone.¹⁶

The new grounds of rejection differ from the grounds set forth in the Final Rejection by the further reliance on Reznik; but the Examiner does not withdraw the original grounds. (Ans. 3, § 1, and not providing the subheading “WITHDRAWN REJECTIONS”.)

B. Discussion

The Board’s findings of fact throughout this Opinion are supported by a preponderance of the evidence of record.

Briefly, the Examiner finds that Kahn and Reznik provide teachings that, the Examiner holds, would have rendered the substitution of fuzzy logic-based controllers for conventional controllers obvious, while the

¹⁴ Fred G. Scheufler and William H. Bayard, *Method of drying substrates and use thereof*, U.S. Patent Application Publication 2001/0005525 A1 (2001).

¹⁵ Robert P. Carnahan, *System and method for treating wastewater containing industrial esters*, U.S. Patent No. 5,133,875 (1992).

¹⁶ David E. Livingstone et al., *Regenerable air cleaning device*, U.S. Patent No. 6,454,834 B1 (2002).

remaining references provide teachings that would have rendered obvious the various physical limitations of the claims. (FR 3–4.)

Harshman urges (Br. 6, ll. 1–4) that the Examiner erred harmfully in finding (FR 4, 2d para.) that Kahn teaches a fuzzy controller having a total of five fuzzy output sets. Rather, Harshman argues, Kahn teaches nine rules. (Br. 6, l. 4, citing Khan 3, col. 1, part c.)

The weight of the evidence (Kahn 3, § c, “Rule Base,” listing Rules 1–9) supports Harshman on this point.

Moreover, Harshman argues, the Examiner has not shown how or why four of the nine rules could be eliminated and provide the control described by Kahn. (Br. 6, 1st & 2d full paras.) The addition of Reznik, according to Harshman (Reply¹⁷ 3), does not cure the deficiencies of Kahn. Moreover, in Harshman’s view, the Examiner has not come forward with any credible evidence or analysis based on Reznik, Kahn, and the other references, that the removal of four of the nine rules “could be rules that the combination of [the other prior art references] would not require for the asserted combination.” (*Id.* at last para.) That conclusion, according to Harshman, “is pure speculation, unsupported by anything in any of the cited references.” (*Id.*)

Again, the weight of the evidence supports Harshman. Both Kahn and Reznik are relatively “high level” discussions of fuzzy proportional integral derivative (“fuzzy PID”) controllers for industrial applications. As such, it should not be surprising that a modification of a specific set of

¹⁷ Reply Brief, filed 17 December 2018 (“Reply”).

control rules might be characterized as conforming with general goals such as “provid[ing] a better transitory and steady state performance as compared with a conventional PID controller” (FR 4, 2nd & 3rd paras., last sentences), or minimizing computational requirements (*id.* at 4th para., last sentence.) But, without a demonstration that the ordinary worker would have been motivated by prior art teachings to make such modifications, such an argument is, in Harshman’s words, “pure speculation.” (Reply 3, 4th full para.) Mere argument cannot take the place of evidence where, as here, findings of fact are required. In the present case, the Examiner has not come forward with such evidence, nor with a plausible, detailed argument, why the nine rules described by Kahn are, given the physical criteria of the processes and apparatuses described by Parker and the other references, equivalent to, or would have been obvious to modify to a five-rule fuzzy logic system within the scope of the appealed claims. Nor has the Examiner explained what five rules would have been the obvious result of the proposed modifications of the nine rules described by Kahn.

The Examiner raises a further argument that, due to the “open” transitional phrase, “comprising,” the claims, which require “a total of five rules,” are open to additional rules. (Adv.¹⁸ 2, last para.; Ans. 11.) As Harshman points out (Br. 5), our reviewing court has repudiated repeatedly this argument. *Dippin’ Dots, Inc. v. Mosey*, 476 F.3d 1337, 1343 (Fed. Cir. 2007) (“[c]omprising’ is not a weasel word with which to abrogate claim limitations [quoting *Spectrum Int’l, Inc. v. Sterilite Corp.*, 164 F.3d 1372, 1380 (Fed. Cir. 1988)] . . . Those six enumerated steps must,

¹⁸ Advisory Action communicated 24 May 2018 (“Adv.”)

however, all be practiced as recited in the claim for a process to infringe.”). Both *Dippin’ Dots* and *Spectrum* are precedential opinions of the Federal Circuit, and although they rule on patented claims rather than claims in an application, the Examiner has not come forward with a credible explanation why the holdings are not precedential with respect to claims on appeal during examination.

We are persuaded by Harshman’s arguments that the Examiner’s factual findings and legal conclusions are harmfully erroneous as to independent claim 14. The Examiner makes no findings regarding the remaining references that cure the deficiencies of the principal rejections. We therefore reverse the remaining rejections.

CONCLUSION

The Examiner’s rejections are reversed.

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
14, 18, 22, 30–34, 43, 44, 46–49	103	Parker, Turschmid, Reznik, and Khan		14, 18, 22, 30–34, 43, 44, 46–49
35	103	Parker, Turschmid, Reznik, Khan, and Amir		35
36	103	Parker, Turschmid, Reznik, Khan and Osterwald		36
37	103	Parker, Turschmid, Reznik, Khan, and Scheufler		37
42	103	Parker, Turschmid, Reznik, Khan, and Carnahan		42
45	103	Parker, Turschmid, Reznik, Khan, and Livingstone		45

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Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
Overall Outcome				14, 18, 22, 30-37, 42-49

REVERSED