Trials@uspto.gov
Tel: 571-272-7822

Paper 43
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HAYWARD INDUSTRIES, INC.,
Petitioner,

v.

PENTAIR WATER POOL AND SPA, INC.,
Patent Owner.

Case IPR2013-00287
Patent 7,704,051 B2

Before STEPHEN C. SIU, BRIAN J. McNAMARA, and JAMES B. ARPIN, *Administrative Patent Judges.*

ARPIN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Hayward Industries, Inc. ("Petitioner") filed a Petition requesting *inter partes* review of claim 1 of U.S. Patent No. 7,704,051 B2 (Ex. 1001, "the '051 Patent"). Paper 1 ("Pet."), 1. Pentair Water Pool and Spa, Inc. ("Patent Owner") filed a Preliminary Response. Paper 5 ("Prelim. Resp."). On November 20, 2013,

we issued a Decision on Institution (Paper 8, "Dec. on Inst."), instituting *inter partes* review of claim 1 on a single ground of unpatentability. Dec. on Inst. 30. Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 26, "PO Resp."), and Petitioner filed a Reply (Paper 29, "Pet. Reply") thereto.

The parties requested and appeared at an oral hearing before us on August 15, 2014. The record includes a transcript of the hearing. Paper 42 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73, addresses issues and evidence raised during trial. For the reasons that follow, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that claim 1 of the '051 Patent is unpatentable.

A. The '051 Patent

The '051 Patent generally relates to pump controllers for use with a pump having a motor, the pump connected to a water distribution system. Ex. 1001, col. 3, ll. 40–62. The pump controller comprises two components: a digital signal processor and a microcontroller. *Id.* at col. 4, l. 64–col. 5, l. 67. The configuration of the pump controller of a pumping system, as recited in the challenged claim, is illustrated by the schematic depicted in annotated Figure 1 of the '051 Patent, reproduced below:

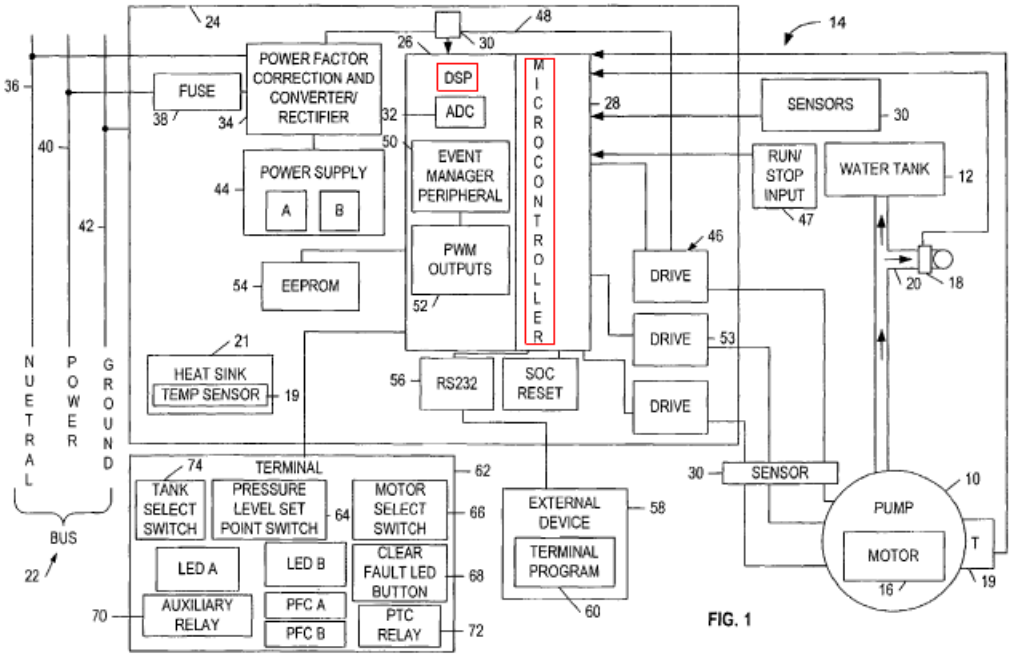

FIG. 1

Annotated Figure 1 "is a schematic illustration of a pump, a water tank, and a pump control system according to one embodiment of the invention." *Id.* at col. 2, ll. 36–38.

In Figure 1, pump controller 24 comprises two components, which are depicted above as boxed in red: digital signal processor (DSP) 26 and microcontroller 28. *Id.* at col. 4, ll. 53–67. DSP 26 is programmed for three functions: (1) to perform a self-calibration procedure to determine at least one of a gain value of the motor and a minimum non-zero flow speed of the motor (Ex. 1001, col. 13, l. 64–col. 14, l. 7; col. 14, l. 64–col. 15, l. 6; col. 16, ll. 8–40); (2) to operate the motor in a limp mode (*id.* at col. 1, l. 64–col. 2, l. 6); and (3) to detect fault conditions in the water distribution system (*id.* at col. 12, ll. 22–49). In particular, DSP 26 may perform a self-calibration procedure to determine a gain value or a minimum non-zero flow speed, or both. *See id.* at col. 14, l. 64–col. 15, l. 6. The gain value may be an integral gain or a proportional gain and, arguably,

may be determined independently or based on the minimum non-zero flow speed. *Id.* at col. 16, ll. 8–40; *see* Prelim. Resp. 43–46. DSP 26 also may control the power supplied to pump motor 16 from power supply 44 via power factor correction and converter/rectifier 34 and, thereby, to operate motor 16 in a limp mode. Ex. 1001, col. 7, l. 3–col. 8, l. 3.

As noted above, microcontroller 28 also may perform three functions: (1) to communicate with the digital signal processor (Ex. 1001, col. 5, ll. 6–15); (2) to receive inputs from sensors in the water distribution system (*id.* at col. 6, ll. 35–59); and (3) to coordinate serial communications with a user input device (*id.* at col. 5, ll. 2–3; col. 9, l. 64–col. 10, l. 2). As depicted in Figure 1, DSP 26 and microcontroller 28 may be joined together, so that microcontroller 28 may communicate with DSP 26. *Id.* at col. 5, ll. 6–15. Microcontroller 28 may receive inputs directly from sensors 30 in the water distribution system or indirectly via terminal 58. *Id.* at col. 5, ll. 43–45; col. 9, ll. 46–64; Figs. 2–13. Moreover, a user may enter commands to microcontroller 28 via serial communications link (RS232) 56 from external device (terminal) 58. *Id.* at col. 9, l. 64–col. 10, l. 2.

B. Illustrative Claim

Independent claim 1 is the sole claim challenged by Petitioner and is reproduced below:

> 1. A pump controller for use with a pump having a motor, the pump connected to a water distribution system, the pump controller comprising:
>
> a digital signal processor, the digital signal processor programmed to perform a self-calibration procedure to determine at least one of a gain value of the motor and a minimum non-zero flow speed of the motor, to operate the motor in a limp mode, and to detect fault conditions in the water distribution system; and
>
> a microcontroller that communicates with the digital signal processor, the microcontroller programmed to receive inputs from

sensors in the water distribution system and to coordinate serial communications with a user input device.

C. References, Declarations, and Depositions

Petitioner and Patent Owner primarily rely upon the following references, declarations, and depositions:

Exhibit	References, Declarations, and Depositions
1010	Declaration of Ali Emadi, Ph.D.
1011	Texas Instruments ("TI"), Inc., Digital Signal Processing Solution for AC Induction Motor, Application Note, BPRA043 (1996) (hereinafter the "TI DSP Motor Solutions Guide"; Ex. 1011)
1012	US 6,481,973 B1 to Struthers (Ex. 1012 or "Struthers")
1020	Declaration of Robert M. Koehl
1061	Deposition of E. Randolph Collins, Ph.D.
2003	Deposition of Ali Emadi, Ph.D.
2004	Declaration of E. Randolph Collins, Ph.D.

D. Ground of Unpatentability

This *inter partes* review involves the following ground of unpatentability:

References	Basis	Claim
Struthers and the TI DSP Motor Solutions Guide	35 U.S.C. § 103(a)	1

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, "[a] claim in an unexpired patent shall be given its broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b); *see also Office Patent Trial Practice Guide*, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012) (*Claim Construction*). Under the broadest reasonable construction standard, a claim term is presumed to have an ordinary and customary meaning as would be understood by one of ordinary skill

in the art in the context of the specification. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). A patentee may act as his or her own lexicographer by providing a particular definition for a claim term in the specification with "reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Generally, in the absence of such a particular definition or other considerations, "limitations are not to be read into the claims from the specification." *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

In our Decision on Institution, we provided constructions for various terms of the challenged claim. Dec. on Inst. 13–21. In particular, we construed the limitation "to perform a self-calibration procedure to determine at least one of a gain value of the motor and a minimum non-zero flow speed of the motor," and specifically, the phrases "minimum non-zero flow speed of the motor" and "gain value of the motor." *Id.* at 15–18. Further, we provided constructions for the terms "limp mode" and "water." *Id.* at 19–21.

Patent Owner argues that our constructions of the limitation "to perform a self-calibration procedure to determine at least one of a gain value of the motor and a minimum non-zero flow speed of the motor," and, in particular, the included phrase "minimum non-zero flow speed," as well as the phrase "to operate the motor in a limp mode," are inconsistent with the Specification of the '051 Patent. PO Resp. 6–22. Further, Patent Owner argues that our construction of the term "water" is unreasonable and inconsistent with the Specification of the '051 Patent. *Id.* at 22–23.

1. To perform a self-calibration procedure to determine at least one of a gain value of the motor and a minimum non-zero flow speed of the motor

Claim 1 recites that the pump controller comprises a digital signal processor programmed "to perform a self-calibration procedure to determine at least one of a gain value of the motor and a minimum non-zero flow speed of the motor." The

Specification of the '051 Patent does not define expressly this limitation. A definition of the verb "to calibrate" is "to set or check the graduation of (a quantitative measuring instrument)." RANDOM HOUSE WEBSTER'S COLLEGE DICTIONARY 188 (2d Random House ed. 1999) (Ex. 3002). The prefix "self" is "a combining form of SELF, appearing in various parts of speech, usu. with the implied notion that . . . the subject of a given predicate acts or is effective without assistance (. . . *self-loading* . . .)." *Id.* at 1189 (Ex. 3002). Thus, for purposes of our Decision on Institution, we construed this limitation to mean that the digital signal processor of claim 1, itself, sets or checks the graduation in determining *at least one of* a gain value of the motor and a minimum non-zero flow speed of the motor.[1] Petitioner agrees with this construction of the limitation. Pet. Reply 5.

Patent Owner argues that "it is the DSP that is programmed to perform the self-calibration procedure. *Manual or other non-autonomous or non-automatic calibration that is not performed by the DSP is not equivalent*. The self-calibration procedure is autonomously and automatically performed by the DSP, hence the self-calibration language." Prelim. Resp. 9 (underlining in original; emphasis added). Although the Specification describes that the self-calibration may be performed automatically (*see* Ex. 1001, col. 15, ll. 32–36), the Specification describes that self-calibration may be initiated by the user (*see id.* at col. 15, ll. 41–44). *See* Pet. Reply 5 (citing Ex. 1001, col. 9, ll. 64–67). Thus, we conclude that the DSP may perform the self-calibration procedure *automatically*, but need not perform the procedure *autonomously*. *See* PO Resp. 21.

[1] *Starhome GmbH v. AT&T Mobility LLC*, 743 F.3d 849, 856 (Fed. Cir. 2014) ("[J]udges are free to rely on dictionaries at any time during the process of construing claims 'so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents.'") (citations omitted).

Patent Owner argues, however, that the "self-calibration procedure" recited in claim 1 only "sets," but does not involve "checking," at least one of a gain value of the motor and a minimum non-zero flow speed of the motor. PO Resp. 20. Nevertheless, as Patent Owner acknowledges, the gain value may be "set" *after* digital signal processor determines the minimum non-zero flow speed. *Id.* (citing Ex. 1001, col. 14, ll. 33–43). Further, in the pump controller, "a user can set *or alter* the *stored* 'minimum non-zero flow speed' to a *different* value." *Id.* (citing Ex. 1001, col. 14, ll. 14–46, 59–63) (emphases added); *see also* Ex. 2004 ¶ 32 ("In many cases, it would be most practical if the motor's range of operating speeds had a minimum value, *set by the user or some other procedure*, that is higher than the threshold value.") (emphasis added). We are persuaded that in order to set a gain value after a minimum non-zero flow speed or to alter a previously set speed, the digital signal processor is capable, as part of its self-calibration procedure, of checking the gain value or the minimum non-zero flow speed of the motor, or both. Consequently, we construe this limitation to mean that the digital signal processor of claim 1, itself, sets or checks the graduation in determining either (1) a gain value of the motor or (2) a minimum non-zero flow speed of the motor, or both.

In our Decision on Institution, we did not construe expressly the phrase "minimum non-zero flow speed of the motor." PO Resp. 6. Patent Owner argues, however, that the patentee has acted as a lexicographer by *implicitly* defining this phrase in the Specification of the '051 Patent. *See id.* at 6–7. In particular, Patent Owner argues that, because the patentee describes a particular embodiment in which "the controller 24 can take into account the motor speed required for the pump 10 to open any check valves and produce a positive water flow in the water distribution system," this required motor speed "can be referred to as the minimum calibrated speed value or the minimum non-zero flow speed." *Id*. (quoting Ex.

1001, col. 17, ll. 36–39, 44–45). Accordingly, Patent Owner argues that the patentee has given a specific definition to the phrase "minimum non-zero flow speed of the motor" in the Specification and that phrase means a "minimum motor speed capable of producing positive water flow in the water distribution system." *Id.* For the reasons set forth below, we are not persuaded that the patentee acted as a lexicographer and set forth this definition for the claim phrase.

First, we note that the Specification states that controller 24 "*can* take into account the motor speed required for the pump 10 to open any check valves and produce a positive water flow in the water distribution system" and that this required motor speed "*can* be referred to as . . . the minimum non-zero flow speed." Ex. 1001, col. 17, ll. 36–39, 44–45 (emphasis added). We are not persuaded that the Specification sets forth, with "reasonable clarity, deliberateness, and precision," the definition for the phrase proposed by Patent Owner. *Paulsen*, 30 F.3d at 1480. Thus, we determine that the Specification only describes a particular embodiment, but does not establish a clear, deliberate, and precise definition of the phrase.

Second, although Patent Owner argues that its construction is consistent with the ordinary and customary meaning of the phrase (PO Resp. 7–12), Patent Owner's declarant, Dr. Collins, testified that a person of ordinary skill in the art at the time of the invention would understand this phrase to mean "a minimum motor speed capable of producing positive water flow in the water distribution system." *Id.* at 8 (quoting Ex. 2004 ¶ 30). Nevertheless, Parent Owner identifies several embodiments described in the Specification of the '051 Patent in which the flow speed of the motor is more than the minimum motor speed required to produce a positive flow of liquid in a water distribution system in order to achieve some desired purpose. PO Resp. 8–12; *see also* Tr. 78:11–13 (Patent Owner contends

that the "minimum non-zero flow speed" creates any amount of positive flow into the water tank, but above a "trickle"); 79:6–80:6 (a flow greater than a "threshold" of zero).

Third, as Petitioner notes, the Specification describes the sensing of motor speed and the flow of water through the water distribution system and adjusting the motor speed to achieve a desired flow. Pet. Reply 1 (citing Ex. 1001, Fig. 2). Specifically, Petitioner points to an example in which the "minimum non-zero flow speed of the motor" is determined based on a desired flow. With respect to Figure 2, the Specification states that the self-calibration procedure can include a regulation mode during which controller 24 operates pump 10 to raise the pressure in water tank 12 to a desired tank pressure set point. Ex. 1001, col. 13, ll. 64–67. Once the desired tank pressure set point is achieved, "the self-calibration procedure can continue to a search mode. In the search mode, the controller 24 can determine a search pressure by adding a pressure value (e.g., 1 PSI) to the current pressure in the water tank 12." *Id.* at col 14, ll. 4–8. During this search mode, Petitioner notes that "the controller 24 can begin operating the motor 16 at the motor's minimum operating speed and slowly increase the motor speed until the pressure in the water tank 12 exceeds the search pressure." *Id.* at col. 14, ll. 19–25; *see* Pet. Reply 1. Thus, in this embodiment, the minimum non-zero flow speed of the pump motor is determined during the self-calibration procedure to achieve the flow necessary to achieve a desired pressure increase.

Patent Owner argues that Petitioner's proposed construction of this phrase cannot be correct because the Specification describes determining the desired flow from the "minimum non-zero flow speed." PO Resp. 12–14. For example, Patent Owner argues that the Specification describes that the motor speed command is the sum of the minimum non-zero flow speed and the output from the

proportional/integral control algorithm. PO Resp. 13 (citing Ex. 1001, col 17, ll. 40–45). Nevertheless, Patent Owner fails to show where the language of claim 1 requires the determination of motor speed in this manner. Moreover, Patent Owner bases its opposition to Petitioner's construction on exemplary embodiments of the pumping system described in the Specification; and, as noted above, absent a particular definition or other considerations, we do not read the characteristics of described embodiments into claim 1. *Van Geuns*, 988 F.2d at 1184.

We are persuaded by Petitioner that the "minimum non-zero flow speed of the motor" is determined by the *desired* flow of water into the water distribution system. Pet. Reply 1. Consequently, we construe the phrase "minimum non-zero flow speed of the motor" to mean "the minimum speed for achieving a desired flow." *Id.*

2. Limp mode

Claim 1 recites that "the digital signal processor programmed . . . to operate the motor in a limp mode." In the Petition, Petitioner contends that the term "limp mode" means "a state of pump motor operation at reduced power or speed." Pet. 10 (quoting Ex. 1006, 3 n.2). Because we determined that Petitioner's proposed construction of this term is consistent with the description in the Specification of the '051 Patent (*see* Ex. 1001, col. 1, l. 64–col. 2, l. 6), for purposes of our Decision on Institution, we construed the term "limp mode" in the manner proposed by Petitioner. Dec. on Inst. 19.

Patent Owner now disputes this construction and argues that the phrase "to operate the motor in a limp mode" means "to operate the motor at a lower pump operating condition, such as power, relative to a normal operating condition." PO Resp. 14. In particular, Patent Owner argues that, under our initial construction, *any* reduction in motor speed would result in operation in a limp mode. *Id.* at 16.

Because motor power (P) may be calculated by the multiplication of motor torque (T) by motor speed (ω), i.e., P=Tω, a decrease in motor speed coupled with an increase in motor torque may leave motor power unchanged. *Id.* at 15 (citing Ex. 2003, 90:8–14). In a constant torque system, a reduction in speed would result in a reduction in power. Ex. 1061, 154:15–155:8 (asserting that Figure 13 of the '051 Patent depicts a constant torque system); *see* Pet. Reply 3. Thus, Patent Owner argues that our construction is overly broad because it fails to take changes in power or torque properly into consideration. PO Resp. 15–17. Nevertheless, Patent Owner's proposed construction of the claim phrase is dependent on the relationship between "a lower pump operating condition" and "a normal operating condition." These terms do not appear in the Specification of the'051 Patent. According to Patent Owner's proposed construction, however, *power* is only one example of such an operating condition (*cf.* Ex. 1001, col. 17, ll. 18–22 (pressure remains constant during "normal operation")), and Patent Owner's proposed construction does not exclude speed as the "lower pump operating condition." Therefore, Patent Owner's proposed construction suffers from the same alleged deficiencies that Patent Owner attributes to our previous construction.

The Specification of the '051 Patent discloses that, in "the limp mode, the controller 24 can reduce (at 212) *one or both* of an output voltage provided to the motor 16 and an operating frequency of the motor 16 (e.g., reduce the output voltage and the operational frequency along the V/Hz curve of the motor 16)." Pet. Reply 2 (quoting Ex. 1001, col. 18, ll. 19–24 (emphasis added)); *see* PO Resp. 16. During prosecution of the parent application to the '051 Patent, despite the Examiner's assertion that limp mode was "a state of pump motor operation at reduced power or speed" (Ex. 1006, 3 n.2), the Examiner recognized that limp mode was associated with a reduction in power. PO Resp. 17 (citing Ex. 2005, 5,

7–8). Therefore, consistent with the Specification of the '051 Patent, the prosecution of its parent application, and the testimony of Patent Owner's declarant, Dr. Collins, we construe the term "limp mode" to mean "a state of pump motor operation at reduced power or at reduced speed to achieve a reduction in power."

3. Water and water distribution system

With respect to the term "water" we construed that term consistent with its ordinary and customary meaning, i.e., "a transparent, odorless, tasteless liquid, a compound of hydrogen and oxygen, H_2O," and note that the term only appears in claim 1 as part of the term "*water* distribution system." Dec. on Inst. 19–20 (quoting RANDOM HOUSE WEBSTER'S COLLEGE DICTIONARY 1472–3 (Ex. 3002)). Petitioner agrees with our construction of this term "water." Pet. Reply 6.

Patent Owner argues, however, that our construction of this term is unreasonably narrow because it is inconsistent with the description of water distribution systems in the Specification of the '051 Patent. PO Resp. 22. In particular, Patent Owner argues that our construction of "water" is limited to only water and would foreclose the presence of anything else in the "water." *Id.* Because the water in examples of the "water distribution system" described in the Specification of the '051 Patent necessarily includes other elements, such as chlorine, or other liquids, or both, Patent Owner argues that our construction improperly would exclude embodiments of the invention disclosed in the Specification. *Id.* at 22–23.

As we noted in our Decision on Institution, the Specification is replete with references to water distribution systems. Dec. on Inst. 21 (citing Ex. 1001, col. 4, ll. 22–32). Consequently, Patent Owner argues that "water" should be construed to mean "liquids, such as those pumped in residential or commercial well pump

systems, pools and or spa systems, and municipal systems." PO Resp. 23. We agree with the Petitioner, however, that Patent Owner's proposed construction improperly incorporates limitations from the Specification into claim 1. Pet. Reply 6.

The Specification of the '051 Patent distinguishes between "'water' distribution systems and distribution systems *for liquids other than water*, such as hydraulic fluids." Dec. on Inst. 21 (citing Ex. 1001, col. 3, ll. 59–62) (emphasis added). Thus, a proper construction of water must preserve this distinction between water and other liquids. Therefore, for purposes of this decision, we construe the terms "water" and "water distribution system" as limiting claim 1 to pump controllers that are programmed to detect faults and to receive inputs from sensors in systems for the distribution of liquids primarily comprising *water* (*see* Ex. 3002), as opposed to other types of liquids.

For this final decision, we adopt and apply the foregoing constructions, as well as our constructions of other claim terms, as set forth in our Decision on Institution. Dec. on Inst. 13–21. All remaining claim terms and phrases recited in the challenged claim need not be construed expressly here.

B. Asserted Ground of Unpatentability

1. Introduction

We instituted this *inter partes* review on Petitioner's asserted ground of unpatentability that claim 1 of the '051 Patent is rendered obvious over Struthers and the TI DSP Motor Solutions Guide. *See* Pet. 30–33. A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are "such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*,

550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art;[2] and (4) objective evidence of nonobviousness, i.e., secondary considerations.[3] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Patent Owner contends that the combination of the teachings of Struthers and the TI DSP Motor Solutions Guide does not teach or suggest, by a preponderance of the evidence, all of the limitations of claim 1 of the '051 Patent. *See* PO Resp. 2, 23–38.

2. Struthers and the TI DSP Motor Solutions Guide

Petitioner contends that Struthers discloses each and every element of the invention recited in claim 1, except that Struthers discloses that a "fast microprocessor" of the controller is programmed to perform the self-calibration, rather than a digital signal processor, as recited in claim 1.[4] Pet. 17 (emphasis removed (referencing Claim Chart 2, [1.1]–[1.2])). Petitioner acknowledges that Struthers does not disclose explicitly that the controller includes a digital signal processor. *Id.* at 19. Nevertheless, Petitioner argues that the TI DSP Motor Solutions Guide discloses a digital signal processor that (1) communicates with a microcontroller and (2) performs a self-calibration procedure. *Id.* (citing Ex. 1010 ¶¶ 26–35, 44–45, 102–107).

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[2] Patent Owner provides a description of a person of ordinary skill in the relevant art. PO Resp. 5. Petitioner does not contest this description. To the extent that this description is not inconsistent with the description of a person of ordinary skill taught by the applied art, we adopt this description.

[3] Patent Owner does not argue pertinent secondary considerations expressly in its Response to the Petition.

[4] Further, according to Petitioner, Struthers describes that pump 10 has a hose pipe for the delivery of *water*. Pet. 17 (citing Ex. 1012, col. 1, ll. 20–28).

a. Digital signal processor

Referring to Section [1.P] of Claim Chart 2, Petitioner contends that Struthers discloses a method for operating variable speed, submersible pump 10, which is powered by motor 12. Pet. 17 (citing Ex. 1012, Abstract; Figs. 1–3). Referring to Struthers's Figure 2, power module 16 (also referred to as "controller 16" (Ex. 1012, col. 3, ll. 28–30)) comprises microprocessor 24, which communicates with control board 22 carrying a microcontroller. *See* Ex. 1012, col. 2, l. 66–col. 3, l. 46; *cf.* Ex. 1001, Fig. 1 (pump controller 24 includes digital signal processor 26 and microcontroller 28). Further, Petitioner's declarant, Dr. Emadi, testified that Struthers's microprocessor is a digital signal processor. *See* Ex. 2003, 92:19–22.

Struthers teaches that microprocessor 24 is in communication with control board 22, and the TI DSP Motor Solutions Guide teaches the benefits of digital signal processors, such as the Model No. TMS320C24x family of TI digital signal processors. Pet. 20–21; *see* Ex. 1001, col. 5, ll. 3–6 (identifying the Model No. TMS320C240XA family of TI digital signal processors); Ex.1011, 9 (describing the TMS320C24x family of TI digital signal processors). Further, Struthers explains,

> The control board 22 and the microprocessor 24 *together* constitute a controller for the pump unit 10, *and it will be understood that some specific functions may be assigned to either the control board 22 or the microprocessor 24*, depending on the specific construction and programming of each of those components in a particular pump unit 10.

Ex. 1012, col. 3, ll. 48–53 (emphases added); *see* Pet. 17 (Claim Chart 2, [1.1]). Therefore, we are persuaded that Petitioner has shown by a preponderance of the evidence that Struthers's controller comprises a microprocessor, e.g., a digital

signal processor, and a microcontroller, as recited in claim 1, and that the functions described by Struthers may be assigned freely to the components, based on various considerations.

i. Minimum non-zero flow speed of the motor

Petitioner further contends that Struthers teaches that the microprocessor may be programmed to perform a self-calibration procedure, and, in particular, a self-calibration procedure to determine at least a minimum non-zero flow speed of the motor. *See* Pet. 17 (Claim Chart 2, [1.2]); Pet. Reply 8–10. Specifically, Petitioner notes that Struthers determines whether pump unit 10 is pumping at least a threshold amount of liquid, e.g., a desired flow, or at a maximum speed. Referring to Figure 5B, Struthers states,

> Under normal conditions, the controller will then loop repeatedly through steps 112, 116, 120, 124, 126, and 128. The speed will be increased if necessary at steps 130 and 132 until the pump either is pumping *at least the threshold amount of liquid set for step 128, or is running at maximum speed*.

Ex. 1012, col. 8, ll. 3–14 (emphasis added); *see* Pet. 17 (Claim Chart 2, [1.2]). Although Struthers does not state that this "threshold amount of liquid" is a "minimum, non-zero flow speed," Struthers's controller determines whether the pump motor is driving the pump to produce a *desired* flow of liquid. Pet. Reply 9 (citing Ex. 1012, col. 8, ll. 3–17). Further, Struthers explains that, if the controller determines that the pump is not clogged at step 126, the controller advances to step 128, at which it checks the rate of pumping. *See* Ex. 1012, col. 7, l. 60–col. 8, l. 2. In order to determine whether the pump is clogged, however, the pump speed may be selected to be *a minimum speed*, and the pump may be run alternatively forwards and backwards to clear such a clog. Ex. 1012, col. 2, ll. 4–7.

Patent Owner argues that the motor speed to obtain such a desired flow does

not teach the recited, minimum non-zero flow speed. PO Resp. 28–30. In particular, Patent Owner argues that the speed to obtain a threshold flow or the minimum speed described in Struthers is not the minimum motor speed capable of producing a positive flow in the water distribution system. *Id.* at 28. These arguments are based on Patent Owner's construction of the phrase "minimum non-zero flow speed of the motor," which we do not adopt. These examples from Struthers, however, are consistent with the construction of the phrase to mean "the minimum speed for achieving a desired flow." *See supra* Sec. II.A.2.

Patent Owner further argues that, "[e]ven if the speed for the 'threshold amount of liquid' or the 'minimum speed' are considered to be the minimum non-zero flow speed of Claim 1, Struthers does not determine these speeds." PO Resp. 30. Instead, Patent Owner argues that Struthers compares the motor's present speed either to a threshold speed or to a minimum speed. *Id.* According to Patent Owner, "[d]etermining the minimum non-zero flow speed is different than merely performing a comparison." *Id.*

Nevertheless, the language of claim 1 does not draw this distinction. The word "determine" does not prohibit determining by comparison, and Patent Owner points to no language in the claim or in the Specification that would support this definition. *Id.* at 31–32. Further, as acknowledged by Patent Owner, a determination may involve the setting or altering of a specific value for the minimum non-zero flow speed. *Id.* at 30. At least when a motor speed is *altered*, it is changed from a previously set speed. This necessarily involves a comparison of the pervious speed and the altered speed, e.g., a user would not *alter* a speed if the presently set speed already was the speed the user desired. In addition, Patent Owner argues that "Struthers does not disclose or teach *autonomously or automatically* setting a gain value of the motor or a minimum non-zero flow speed

of the motor." *Id.* at 32 (emphasis added). For the reasons discussed above, we conclude that the recited digital signal processor may perform the self-calibration procedure *automatically*, but need not perform the procedure *autonomously*. *See supra* Sec. II.A.1. Struthers teaches that its pump controller is capable of automatic control of pump operation. *E.g.,* Ex. 1012, col. 3, ll. 53–56; col. 6, ll. 19–22. Therefore, we are persuaded that Petitioner has shown by a preponderance of the evidence that Struthers's microprocessor performs a self-calibration procedure to set or check the graduation of the pump controller to determine whether the pump motor is operating at a minimum non-zero flow speed, i.e., "the minimum speed for achieving a desired flow."

Patent Owner further argues that Struthers and the TI DSP Motor Solutions Guide do not teach or suggest a digital signal processor "programmed to perform a self-calibration procedure to determine . . . a gain value of the motor." PO Resp. 32–33. As noted in our Decision on Institution, "[w]ith respect to arguments regarding 'gain values' teachings in the TI DSP Motor Solutions Guide, Petitioner explains that '[t]he proposed combination includes *an additional teaching* with respect to self-calibration, which concerns gain value of the motor and vector control.'" Dec. on Inst. 29 (quoting Pet. 21 (emphasis added)); *see also* Pet. Reply 10–12 (citing Ex. 1011, 8). Nevertheless, claim 1 only requires that the digital signal processor is programmed to perform a self-calibration procedure to determine *either* a gain value of the motor *or* a minimum non-zero flow speed of the motor. *See* Dec. on Inst. 29. In view of the foregoing discussion of the determination of minimum non-zero flow speed, we need not address further the determination of the gain value of the motor.

ii. Limp mode

Struthers's pump controller, e.g., microprocessor 24, may determine when

the torque developed for the pump motor exceeds a maximum for a selected speed. Pet. 17–18 (Claim Chart 2, [1.3]). If the torque exceeds the maximum for the selected speed, Struthers's pump controller reduces the speed of the pump. Ex. 1012, col. 1, ll. 62–65; *see* Pet. Reply 6 (citing Ex. 1012, col. 10, ll. 1–3). In addition, we note that, referring to Figure 5B,

> If the breakdown threshold has been reached at step 136, or if the clog has not been removed at step 140, then the controller tests at step 142 whether the pump is running *at its lowest speed*. If it is not, the controller returns to step 134, and *reduces the speed further*.

Ex. 1012, col. 8, ll. 33–38 (emphases added). Petitioner contends that Struthers teaches that microprocessor 24 may "detect fault conditions in the water distribution system," as recited in claim 1. Pet. 18 (Claim Chart 2, [1.4]). Referring to Figures 5A and 5B, Struthers depicts that control board 22 or microprocessor 24, or both (*see* Ex. 1012, col. 7, ll. 1, 51; col. 8, ll. 17–18), may test whether the tank is empty (step 124), the tank has high water (step 112), the pump is clogged (step 126), and/or other system conditions. Pet. 18 (Claim Chart 2, [1.4] (citing Ex. 1012, col. 6, l. 66–col. 9, l. 12)). Thus, Struthers teaches that reductions in pump motor speed may be triggered by system parameters other than an increase in motor torque. Pet. Reply 6–7 (citing Ex. 1012, Fig. 4); *see also* Ex. 1061, 171:6–172:6 (limp mode trigger could be a parameter other than torque). Therefore, Struthers teaches that a reduction in motor speed may result in a reduction in motor power. In view of the construction of the term "limp mode," set forth above, we are persuaded that Struthers discloses that the pump controller may operate the pump in a "limp mode," i.e., "a state of pump motor operation at reduced power or at reduced speed to achieve in a reduction in power."

Patent Owner argues that Struthers describes a constant power system in which the motor speed must be reduced to allow motor torque to increase and that

Struthers adjusts motor speed in response to changes in motor torque in order to maximize the available power to the pump motor. PO Resp. 26 (citing Ex. 2003, 90:8–14; Ex. 2004 ¶ 41). Consequently, Patent Owner argues that motor speed adjustments to maintain available power are not the same as operating the pump motor in a limp mode. *Id.* at 26 (citing Ex. 1012, col. 1, ll. 62–67; Ex. 2004, ¶¶ 39–40).

Although Patent Owner argues that "[w]hat is *implicit* to one of ordinary skill, is that the method of Struthers assumes that the available power remains constant" (PO Resp. 27 (emphasis added)), Patent Owner does not show where Struthers discloses or implies that available power remains constant. Moreover, claim 1 simply recites that "the digital signal processor programmed to perform a self-calibration procedure . . . to operate the motor in a limp mode" and does not specify whether the available motor power is constant or variable and does not specify the parameters (or events) that can trigger operation in a limp mode. Dr. Emadi and Dr. Collins acknowledge the relationship between motor torque, speed, and power, but neither declarant states that Struthers's system operates at a constant motor power. Ex. 2003, 89:11–15 ("Could be you are reducing speed and power and torque, that's a limp mode, too."); Ex. 2004 ¶ 41 ("Thus, during this reduced speed clog removal process, the torque and current levels *are likely to be excessively high* – which could be tolerated for short intervals during a clog removal – but do not constitute a limp mode where the motor's operational limits are not exceeded.") (emphasis added). Dr. Collins's cited testimony, however, is limited to clog removal (Ex. 2004 ¶¶ 39–41), and, as we noted above, that is only one of many parameters that may trigger limp mode (*see* Pet. Reply 6–7). Thus, we are persuaded that Petitioner has shown by a preponderance of the evidence that Struthers's microprocessor may be programmed to cause the pump motor to

operate in a limp mode, as recited in claim 1.

b. Microcontroller

Turning to the second recited component of claim 1, Petitioner contends that Struthers teaches "a microcontroller that communicates with the digital signal processor, the microcontroller programmed to receive inputs from sensors in the water distribution system and to coordinate serial communications with a user input device." Pet. 18–19 (Claim Chart 2, [1.5]–[1.7]). As noted above, Struthers expressly teaches that control board 22 may include a microcontroller. *Id.* at 18 (citing Ex. 1012, col. 3, ll. 10–13). Further, referring to Struthers's Figure 2, Petitioner contends that a microcontroller of control board 22 receives inputs from sensors 70 and 72 via digital serial communications bus 36. *Id.* (Claim Chart 2, [1.6]); *see also* Ex. 1012, col. 3, ll. 62–63 ("control board 22 is in communication with a serial digital communication bus 36 comprising signal lines 38"); col. 4, ll. 32–35 (control board 22 receives input from level sensor 70 and dielectric oil sensor 72), 47–52 (level sensor 70 is connected to control board 22). Struthers's Figure 2 further depicts a programming/diagnostic interface 74 connected via signaling lines 38 and digital serial communications bus 36 to control board 22. Pet 18–19 (Claim Chart 2, [1.7]). Referring to serial digital communication bus 36 of Figure 2, Struthers explains,

> *The signal lines 38 also allow for input from, and output to, external devices*. As shown in FIG. 2, the signal lines 38 may connect the control board 22 to a programming/diagnostic interface 74, and may enable the control board to control . . . a modem 80 by which status information can be sent to or received from a remote monitor 82, which may be, for example, a fax, pager, display, a printer, or another computer.

Ex. 1012, col. 4, ll. 38–46 (emphasis added).

Patent Owner does not argue that Struthers does not teach or suggest the

microcontroller, as recited in claim 1. Therefore, we are persuaded that Petitioner has shown by a preponderance of the evidence that Struthers teaches or suggests the microcontroller component of the pump controller, as recited in claim 1.

c. Reason to combine Struthers and the TI DSP Motor Solutions Guide

Petitioner contends that a person of ordinary skill in the relevant art would have had reason to modify the teachings of Struthers in view of the teachings of the TI DSP Motor Solutions Guide because Struthers teaches that microprocessor 24 is in communication with control board 22, and because, as noted above, the TI DSP Motor Solutions Guide teaches the benefits of digital signal processors, such as the Model No. TMS320C24x family of TI digital signal processors. Pet. 20–21; *see* Ex. 1001, col. 5, ll. 3–6 (identifying the Model No. TMS320C240XA family of TI digital signal processors); Ex.1011, 9 (describing the TMS320C24x family of TI digital signal processors). These devices are used in accordance with "their commonly regarded functions in the art." Pet. Reply 7–8, 12 (citing Ex. 1010 ¶¶ 29–45; Ex. 2003, 92:3–100:24, 114:15–117:10). Further, Petitioner contends that the substitution of the digital signal processor of Struthers, such as for those taught by the TI DSP Motor Solutions Guide, merely would be the substitution of one known element for another to obtain predictable results. Pet. 21; *see also KSR*, 550 U.S. at 417 ("If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.").

Patent Owner argues that because the problem addressed by Struthers and the problem addressed by the pump controller of claim 1 of the '051 Patent are different, a person of ordinary skill in the art would not have had reason to modify

Struthers to achieve the pump controller of claim 1. PO Resp. 24–26. In particular, Patent Owner argues that "[t]he methods taught by Struthers include reducing the pump's speed while increasing the pump's torque, in an attempt to move the clog through the grinder pump." *Id.* at 24–25 (citing Ex. 1012, col. 8, ll. 17–39). On the other hand, Patent Owner argues that "[t]he '051 Patent addresses the problem of how to save time and energy by always starting a pump at a speed that will result in some flow through the pump and into the particular hydraulic system in which the pump is installed." *Id.* at 25. As the U.S. Supreme Court explained, however, in performing the obviousness analysis, adjudicative bodies should not look only to the problem that the patentee was trying to solve. *KSR*, 550 U.S. at 420. "Under the correct analysis, any need or problem known in the field . . . and addressed by the patent can provide a reason for combining the elements in the manner claimed." *Id.* Because we determine that the recited pump controller of claim 1 addresses problems relevant to the teachings of Struthers, those problems may provide a reason to combine the teachings of Struthers and the TI DSP Motor Solutions Guide, in the manner proposed by Petitioner.

Patent Owner further argues that "the combination of Struthers and [the TI DSP Motor Solutions Guide] does not teach the claimed division of responsibility between the digital signal processor and the microcontroller, such that any conclusion to the contrary relies, respectfully, on an impermissible hindsight reconstruction [of the pump controller recited in claim 1.]" PO Resp. 24; *see id.* at 33–38. We note that

> Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill [in the art] at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure, such

> a reconstruction is proper.

In re McLaughlin, 443 F.2d 1392, 1395 (CCPA 1971).

For the reasons set forth above, we are persuaded that Petitioner has shown that Struthers and the TI DSP Motor Solutions Guide teach or suggest all of the limitations recited in claim 1, including the functions attributed to the digital signal processor and the microcontroller. Moreover, Struthers teaches that "it will be understood that some specific functions may be assigned to either the control board 22 or the microprocessor 24, depending on the specific construction and programming of each of those components in a particular pump unit 10." Ex. 1012, col. 3, ll. 49–53; *see* Tr. 7:23–9:18. Thus, we are persuaded that the combination of the teachings of Struthers and the TI DSP Motor Solutions Guide does not rely on impermissible hindsight and that Petitioner has presented adequate reasons for combining the teachings of Struthers and the TI DSP Motor Solutions Guide to achieve the pump controller recited in claim 1 of the '051 Patent.

From our review of the record and in view of the foregoing discussion, we conclude that Petitioner demonstrates by a preponderance of the evidence that independent claim 1 of the '051 Patent is rendered obvious by the combination of the teachings of Struthers and the TI DSP Motor Solutions Guide.

C. Motion to Exclude Evidence

Petitioner filed a Motion to Exclude certain evidence. Paper 33 ("Mot. to Excl."). Patent Owner filed an Opposition to Patent Owner's Motion to Exclude (Paper 35 ("Opp. to Excl.")), and Petitioner filed a Reply to Patent Owner's Opposition (Paper 37 ("Excl. Reply"). Petitioner moves to exclude pages 189–198 of Exhibit 1061, because Patent Owner's counsel is alleged to have coached Patent Owner's declarant, Dr. Collins, improperly, prior to his redirect testimony. Mot. to Excl. 1–4. If we grant Petitioner's Motion to Exclude Dr. Collins's redirect

testimony, Petitioner also moves that we exclude Petitioner's cross-examination of the redirect examination of Dr. Collins on pages 198–230 of Exhibit 1061. *Id.* at 1. As movant, Petitioner bears the burden of proving that it is entitled to the requested relief. *See* 37 C.F.R. § 42.22.

After the completion of Petitioner's cross-examination of Dr. Collins, Patent Owner's counsel and Dr. Collins retired to another room for about two and one-half hours before returning to deposition room to begin redirect examination. Mot. to Excl. 2; *see* Ex. 1061, 188:24–189:4. Petitioner contends that Patent Owner counsel's lengthy conference with Dr. Collins is prohibited under the Testimony Guidelines set forth in Appendix D of the Office Patent Trial Practice Guide. *See* 77 Fed. Reg. at 48,772–73 (Aug. 14, 2012). We disagree.

The Testimony Guidelines provide that:

> *Once the cross-examination of a witness has commenced, and until cross-examination of the witness has concluded*, counsel offering the witness on direct examination shall not: (a) consult or confer with the witness regarding the substance of the witness' testimony already given, or anticipated to be given, except for the purpose of conferring on whether to assert a privilege against testifying or on how to comply with a Board order; or (b) suggest to the witness the manner in which any questions should be answered.

Id. at 48,772 (emphasis added).

Petitioner contends that the length of time during which Patent Owner's counsel and Dr. Collins conferred and the relative brevity of Patent Owner's redirect examination of Dr. Collins is evidence of improper coaching. Mot. to Excl. 4–6. During the oral hearing, however, Petitioner acknowledged that, aside from the length of the break between the end of cross-examination and the beginning of redirect examination and the relative brevity of the redirect examination, Petitioner has no other evidence proving that impermissible coaching

occurred during the conference. Tr. 22:14–23:3. The length of the conference between Patent Owner's counsel and Dr. Collins and the relative brevity of Patent Owner's redirect examination of Dr. Collins are insufficient evidence for us to conclude that improper coaching occurred during the conference.

For the reasons set forth above, we deny Petitioner's Motion to Exclude with respect to pages 189–230 of the Exhibit 1061.

III. CONCLUSION

Based on the foregoing discussion, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable under 35 U.S.C. § 103(a) over Struthers and the TI DSP Motor Solutions Guide.

IV. ORDER

In consideration of the foregoing, it is

ORDERED that Petitioner has shown by a preponderance of the evidence that claim 1 of the '051 Patent is unpatentable under 35 U.S.C. § 103(a) over Struthers and the TI DSP Motor Solutions Guide;

FURTHER ORDERED that Petitioner's Motion to Exclude Evidence is *denied*; and

FURTHER ORDERED that, because this is a final decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

FOR PETITIONER:

Steven Halpern
shalpern@mccarter.com
Mark Nikolsky
mnikolsky@mccarter.com

FOR PATENT OWNER:

Raye Daugherty
raye.daugherty@quarles.com
Joel Austin
joel.austin@quarles.com