

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AQUARIUS SPECTRUM, LTD.,
Petitioner,

v.

ECHOLOGICS, LLC, MUELLER INTERNATIONAL, LLC, and
MUELLER CANADA, D/B/A/ ECHOLOGICS,
Patent Owner.

IPR2022-00153
Patent 7,475,596 B2

Before JO-ANNE M. KOKOSKI, WESLEY B. DERRICK, and
AVELYN M. ROSS, *Administrative Patent Judges*.

DERRICK, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

On December 7, 2021, Aquarius Spectrum, Ltd. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–11 of U.S. Patent No. 7,475,596 B2 (Ex. 1001, “the ’596 patent”). On March 15, 2022, Echologics, LLC, Mueller International, LLC, and Mueller Canada, Ltd. d/b/a Echologics (collectively “Patent Owner”) elected to waive the preliminary response to the Petition. Paper 8.

Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted “unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.”¹ Upon consideration of the arguments and evidence presented by Petitioner, standing unopposed with Patent Owner waiving the preliminary response, we are persuaded that Petitioner has demonstrated, under 35 U.S.C. § 314(a), a reasonable likelihood that it would prevail in showing the unpatentability of at least one of the challenged claims. Accordingly, we institute an *inter partes* review of the challenged claims.

A. *Real Parties in Interest*

Petitioner identifies itself as the real party in interest, noting that it is a subsidiary of Hutchinson Water International Holdings Pte, Limited. Pet. viii. Patent Owner identifies Echologics, LLC, Mueller International, LLC, Mueller Canada, Ltd. d/b/a Echologics, and Mueller Water Products, Inc., their parent company, as the real parties in interest. Paper 7.

¹ By regulation, the Director has delegated the decision whether to institute trial to the Board. 37 C.F.R. § 42.4(a).

B. Related Proceedings

The Parties identify *Echologics, LLC v. Aquarius Spectrum, Ltd.*, 1:20-cv-04956-LMM (N.D. Ga.), as a related proceeding. Pet. viii; Paper 7.

C. The '596 Patent

The '596 patent is titled “Non-Destructive Testing of Pipes,” and issued on January 13, 2009, from application No. 11/952,582, filed December 7, 2007, which was a division of application No. 11/156,573, filed on June 21, 2005. Ex. 1001, codes (21), (22), (45), (54), (62).

The '596 patent relates to “perform[ing] a non-destructive evaluation of a pipe carrying a fluid” by: (1) determining “an actual value representative of the propagation velocity of an acoustic disturbance propagating between two longitudinally separated points on the pipe”; (2) computing “[a] corresponding predicted value for the propagation velocity . . . as a function of at least one wall thickness parameter”; and (3) computing [t]he wall thickness parameter . . . by matching the actual value with the predicted value.” *Id.* at code (57).

The '596 patent discloses determining “the pipe wall thickness . . . [of fluid-filled pipes (e.g., water pipes)] from the average propagation velocity of low-frequency acoustic disturbances in the pipe (e.g., pressure fluctuations).” *Id.* at 1:61–64. The actual propagation velocity determined by measurement is then matched to a calculated propagation velocity based on known constants and parameters, which include varying values of pipe wall thickness, thus, determining the actual pipe wall thickness based on the pipe wall thickness values required to obtain a matching propagation velocity. *Id.* at 2:8–20.

The '596 patent discloses that “[t]he propagation velocity . . . can be determined . . . by measuring the time delay between acoustic signals

measured at two points on the pipe that are a known distance apart (e.g., control valves or fire hydrants).” *Id.* at 2:29–34. The ’596 patent illustrates an apparatus for this method of determining propagation velocity in Figure 1a, reproduced below.

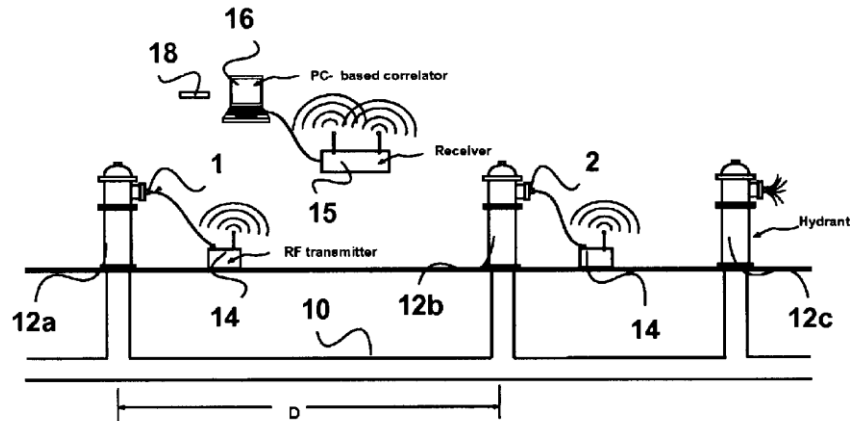


Fig. 1a

Ex. 1001, Fig. 1a (illustrating apparatus for measuring propagation velocity of buried pipes). Figure 1a depicts buried water pipe 10 connecting hydrants 12a, 12b, 12c, with hydrants 12a and 12b separated by distance D. *Id.* at 12:31–33, Fig. 1a. Hydrant 12a has attached sensor 1 and hydrant 12b has attached sensor 2. *Id.* at 12:33–34. Sensors 1 and 2 each have attached RF transmitters 14 for transmitting signals to receiver 15 connected to PC 16 running a program transferred to its hard drive from a storage medium 18. *Id.* at 12:50–53, Fig. 1a. As depicted, hydrant 12c is the acoustic source. *Id.* at 12:34–35, Fig. 1a. The propagation velocity (v) is determined by measuring the propagation times to hydrants 12a and 12b and dividing distance D between hydrants 12a and 12b by the difference in propagation time between hydrants 12a and 12b (ΔT), according to the expression $v=D/\Delta T$. *Id.* at 12:37–41.

The '596 patent discloses formulas for calculating theoretical propagation velocities based on known constants and parameters, including formula (20) for “a [thin-walled] pipe having uniform thickness profile,” reproduced below.

$$v = v_o / \sqrt{1 + c \frac{D}{t} \frac{K}{E}}$$

Ex. 1001, 6:60–7:12 ($v = v_o / \text{square root } (1 + c (E/t) (K/E))$). In this formula, v is the calculated velocity of acoustic waves through the pipe (*id.* at 7:2–12), v_o is the propagation velocity of acoustic waves in an unbounded fluid body (*id.* at 3:46–56), c is a factor that accounts for the fixation method of pipe (*id.* at 6:1–8), D is the internal diameter of the pipe (*id.* at 9:51), t is the thickness of the pipe wall (*id.* at 5:38), K is the bulk modulus of elasticity of the fluid (*id.* at 9:51–52), and E is the elastic modulus of the pipe material (*id.* at 9:52–53).

The '596 patent also discloses that “[t]he errors resulting from [the] assumption that the pipe is thin-walled, . . . are small for the purpose of locating pipe leaks. However, for thickness measurements, *the error may not be sufficiently small.*” Ex. 1001, 7:13–16 (emphasis added). The '596 patent, accordingly, provides further equations that account for additional factors and teaches relying on these to obtain more accurate calculated values. *Id.* at 7:24–9:1.

D. Challenged Claims

Petitioner challenges claims 1–11 of the '596 patent. Pet. 1–2. Claims 1 and 8 are illustrative of the subject matter at issue and are reproduced below:

1. An apparatus for the non-destructive condition assessment of a pipe carrying a fluid, comprising:
 - a) first and second sensors for detecting an acoustic disturbance propagating past two longitudinally separated points on said pipe; and
 - b) a processor receiving inputs from said first and second sensors and programmed to:
 - (i) determine an actual value representative of the propagation velocity of said acoustic disturbance;
 - (ii) compute a corresponding predicted value for the propagation velocity as a function of at least one wall thickness parameter of said pipe by using a theoretical model for the propagation of acoustic waves in said pipe that assumes said pipe has a finite wall thickness with a predetermined circumferential thickness profile; and
 - (iii) compute said wall thickness parameter by matching said actual value with said predicted value.

Ex. 1001, 14:11–29.

8. A storage medium storing coded instructions for instructing a computer to:
 - accept signals from sensors responsive to an acoustic disturbance propagating along a pipe;
 - compute an actual value representative of the propagation velocity of said acoustic disturbance by dividing the difference between the distances of said sensors from corresponding acoustic source by the time delay between said acoustic disturbances;
 - compute a corresponding predicted value for the propagation velocity as a function of at least one wall thickness

parameter of said pipe by using a theoretical model for the propagation of acoustic waves in said pipe that assumes said pipe has a finite wall thickness with a predetermined circumferential thickness profile; and

compute said wall thickness parameter by matching said actual value with said predicted value.

Id. at 14:56–15:5.

E. The Asserted Grounds of Unpatentability

Petitioner asserts that claims 1–11 would have been unpatentable on the following grounds:

References/Basis	35 U.S.C. § ²	Claim(s) Challenged
Hunaidi Patent ³	103(a)	1–8
Hunaidi Patent, Hunaidi Article ⁴	103(a)	1–11
Hunaidi Patent, Nishino ⁵	103(a)	1–8
Hunaidi Patent, Nishino, Hunaidi Article	103(a)	3, 6, 9–11
Hunaidi Patent, Brophy ⁶	103(a)	1–8
Hunaidi Patent, Brophy, Hunaidi Article	103(a)	3, 6, 9–11

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the ’596 patent was filed before this date, the pre-AIA version of § 103 applies. Ex. 1001, code (22).

³ Hunaidi, US 6,561,032 B1, issued May 13, 2003 (Ex. 1003, “Hunaidi Patent”).

⁴ Hunaidi et al., *Acoustic methods for locating leaks in municipal water pipe networks*, *International Conference on Water Demand Management*, Int’l Conference on Water Demand Management: 30 May 2004, Dead Sea, Jordan (Ex. 1004, “Hunaidi Article”).

⁵ Nishino et al., *Estimating the diameter/thickness of a pipe using the primary wave velocity of a hollow cylindrical guided wave*, *Applied Physics Letters* 85(6), 1077–79 (2004) (Ex. 1009, “Nishino”).

⁶ Brophy et al., US 5,970,434, issued Oct. 19, 1999 (Ex. 1007, “Brophy”).

Petitioner relies on the Declaration of Robert J. Wilkens, Ph.D., P.E. (Ex. 1002) in support of its challenge.

II. ANALYSIS

A. *Level of Ordinary Skill in the Art*

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. See *Custom Accessories, Inc. v. Jeffrey-Allan Industries, Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. U.S.*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

Petitioner contends that a person of ordinary skill in the art “is a person with a degree in mechanical engineering, chemical engineering, or physics, and approximately three to five years of combined work experience and/or graduate work in fluid dynamics.” Pet. 10 (citing Ex. 1002 ¶¶ 24–25). As Patent Owner has waived its preliminary response, Petitioner’s contended level of ordinary skill stands uncontested.

On this record, we find Petitioner’s definition of the level of ordinary skill reasonable and, therefore, adopt it for the purposes of this Decision.

B. *Claim Construction*

We apply the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). See 37 C.F.R. § 42.100(b) (2020). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning.” *Phillips*, 415 F.3d at 1312. “[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the

invention.” *Id.* at 1313. Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner contends that “the claims at issue are [to be] construed based on the ordinary and customary meaning that would have been understood by a [person of ordinary skill in the art] on June 21, 2005,” but does not offer any explicit construction for any claim term. Pet. 10–11. As Patent Owner waived its preliminary response, it does not set forth any claim construction position at this time.

On this record, we decline to construe any claim terms beyond the limited extent we do so below in our analysis, because it is not necessary to do so in reaching our Decision on Institution.

C. Principles of Law

Petitioner challenges claims under 35 U.S.C. § 103. A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented 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; and (4) if in evidence, objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) as “requiring [*inter partes* review] petitions to identify ‘with particularity . . . the evidence that supports the grounds for the challenge to each claim’”). When challenging claims based on obviousness, the Petitioner must show that “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016) (citations omitted). The burden of persuasion, whether for anticipation or for unpatentability for obviousness, never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)) (discussing the burden of proof in *inter partes* review).

D. Asserted Obviousness over the Hunaidi Patent

Petitioner challenges claims 1–8 as unpatentable for obviousness over the Hunaidi Patent. Pet. 11–35.

1. Overview of the Hunaidi Patent (Ex. 1003)

The Hunaidi Patent is titled “Non-Destructive Measurement of Pipe Wall Thickness” and is directed to determining

The average wall thickness of a pipe carrying a fluid . . . by sensing disturbances in the pipe at two spaced locations, determining the propagation velocity of coupled propagation mode signals . . . resulting from the disturbances, and calculating the average pipe wall thickness between the two locations from the propagation velocity and known constants for the pipe and fluid.

Ex. 1003, codes (54), (57). The vibration source used can be ambient noise in the pipe or can be purposely introduced, e.g., by releasing water from a hydrant. *Id.* at 2:42–46. The Hunaidi Patent discloses that “[t]he propagation velocity depends on the type and size of pipe, i.e., its material, diameter and wall thickness” and that

[the propagation velocity] can be calculated theoretically by the follow equation:

$$c = c_o \sqrt{\frac{1}{[1 + \alpha(D/e)(K_w/E_p)]}}$$

where c is the propagation velocity of leak signals in the pipe, c_o is the propagation velocity of sound in an infinite body of water . . . K_w is the bulk modulus of elasticity of water, . . . E_p is the modulus of elasticity of the pipe material, D is internal diameter of the pipe, e is the thickness of the pipe wall, and α is [a] constant that depends on the constraints of longitudinal movement of the pipe.

Ex. 1003, 2:57–3:5 ($c=c_o$ (square root ($1/(1+\alpha(D/e)(K_w/E_p))$)). The Hunaidi Patent further teaches that “[t]he pipe wall thickness [can be] back-calculated by substituting in the above equation the measured value of the propagating velocity and values of all other pipe parameter which are usually known.” *Id.* at 3:8–11.

2. *Independent Claims 1 and 8*

Claim 1: *An apparatus for the non-destructive condition assessment of a pipe carrying a fluid, comprising:*

Claim 8: *A storage medium storing coded instructions for instructing a computer to:*

Petitioner contends that the Hunaidi Patent discloses these claim elements. Pet. 13 (citing Ex. 1003, code (54) (Title), 1:10–23, 4:1–9; Ex. 1002 ¶ 41).

On this record, and for purposes of institution, Petitioner’s showing is sufficient.

Claim 1: *a) first and second sensors for detecting an acoustic disturbance propagating past two longitudinally separated points on said pipe; and*

Claim 8: *accept signals from sensors responsive to an acoustic disturbance propagating along a pipe;*

Petitioner relies on the

Hunaidi Patent disclos[ing] two sensors, such as hydrophones or accelerometers (e.g. Figure 1, sensors 13) for detecting an acoustic disturbance (noise) propagating past two longitudinally separated points (points separated by distance D) on a pipe . . . and that the computer accepts signals from sensors that are responsive to the noise propagating along the pipe.

Pet. 14 (citing Ex. 1003, 2:2–11, 2:47–50, 3:50–59, 4:1–9, 4:17–21).

Petitioner further notes the similarity between the Hunaidi Patent’s Figure 1 and the ’596 patent’s Figure 1a. *Id.* at 15 (citing Ex. 1003, 3:59–62, Fig. 1; Ex. 1001, 2:21–38, 12:31–46, Fig. 1a).

On this record, and for purposes of institution, Petitioner’s showing is sufficient.

Claim 1: b) a processor receiving inputs from said first and second sensors and programmed to: (i) determine an actual value representative of the propagation velocity of said acoustic disturbance;

Claim 8: compute an actual value representative of the propagation velocity of said acoustic disturbance by dividing the difference between the distances of said sensors from corresponding acoustic source by the time delay between said acoustic disturbances;

Petitioner relies on the

Hunaidi Patent disclos[ing] “a processor for determining the propagation velocity” of the acoustic disturbance (noise) . . . [which] receives inputs from the first and second sensors and then determines an actual value for the propagation velocity of the acoustic disturbance by dividing the difference between the distances of said sensors from the corresponding acoustic source by the time delay between said acoustic disturbance[s].

Pet. 16 (quoting Ex. 1003, 6:31–33) (citing Ex. 1003, 2:51–56, 3:56–59, 3:64–67, 4:1–9). Petitioner also relies on Dr. Wilkens’ testimony that the disclosed algorithm to determine the propagation velocity is the same as in the ’596 patent. *Id.* (citing Ex. 1002 ¶¶ 49–50, 52–59). Petitioner also relies on Dr. Wilkens’ testimony that the “cross-correlator 15” depicted in Figure 1 would be understood by a person of ordinary skill in the art “to include the processor, or software operating on the processor of PC 20.” *Id.* at 17 (citing Ex. 1002 ¶ 47); Ex. 1003, 3:57–59.

On this record, and for purposes of institution, Petitioner’s showing is sufficient.

Claims 1 and 8⁷: (ii) compute a corresponding predicted value for the propagation velocity as a function of at least one wall thickness parameter of said pipe by using a theoretical model for the propagation of acoustic waves in said pipe that assumes said pipe has a finite wall thickness with a predetermined circumferential thickness profile; and

Petitioner relies on the Hunaidi Patent disclosing a processor that calculates a predicted value for the propagation velocity using a theoretical model for the propagation of acoustic waves in the pipe. Pet. 17–23. Petitioner relies, in particular, on the use of the Hunaidi Patent’s equation reproduced below.

$$c = c_o \sqrt{\frac{1}{[1 + a(D/e)(K_w/E_\rho)]}}$$

Id. at 18–20 ($c=c_o$ (square root ($1/(1+a(D/e)(K_w/E_\rho))$)); Ex. 1003, 2:25–3:7. Petitioner sets forth that this equation, although using different symbols, is the mathematical equivalent of the ’596 patent’s Equation 20, and supports this contention with the testimony of Dr. Wilkens. *Id.* at 19–20 (citing Ex. 1001, 7:1–12, 3:46–56, 5:38, 6:1–8, 9:51–53; Ex. 1002 ¶¶ 49–50, 52–59; Ex. 1003, 2:57–3:7); *see also id.* at 21 (“The equation in the Hunaidi Patent used to calculate the predicted value for the propagation velocity is the same as Equation 20 of the ’596 patent.”).

Petitioner and Dr. Wilkens also rely on the Hunaidi Patent disclosing that “[t]he pipe wall thickness is an average value” and contend that a person of ordinary skill “would have understood the equation in the Hunaidi Patent

⁷ Claim 8 does not include “(ii)” in its recitation of this clause.

assumes a uniform wall thickness.” Pet. 21 (quoting Ex. 1003, 3:23) (citing Ex. 1003, code (57) (Abstract), 2:8–11, 3:25–28, 3:45–46; Ex. 1002 ¶¶ 60–61); *see also id.* at 21–22 ((citing Ex. 1001 6:59–61, 7:13–15; Ex. 1002 ¶ 60) (discussing that the Hunaidi patent “assum[es] ‘that the pipe is thin-walled,’ and has ‘uniform thickness’” in the same manner that “Equation 20 of the ’596 patent assumes ‘a pipe having [a] uniform thickness profile.’”)).

Petitioner also contends that, “[t]o the extent that the Hunaidi Patent does not explicitly disclose calculating the predicted [wall thickness] value for the propagation value,” doing so as set forth in the claims “would have been obvious” to a person of ordinary skill in the art whose knowledge includes “how to plot an equation with two variables,” and that doing so “would allow a [person of ordinary skill in the art] to quickly and easily determine the wall thickness of a pipe by measuring the actual propagation velocity for that pipe, determining which precalculated theoretical velocity value is the same value (matches) the . . . measured [velocity],” and identifying “the corresponding calculated wall thickness” for the matching “predicted theoretical value.” Pet. 22 (citing Ex. 1002 ¶¶ 62–71). Petitioner highlights that “the ‘propagation velocity,’ and ‘pipe wall thickness’ are the only variables in [the Hunaidi Patent’s] equation,” rather than “known constants,” and contends that “it would have been obvious to a [person of ordinary skill in the art] to plug in the known constants for the pipe and fluid medium and plot the equation . . . of the Hunaidi Patent, which disclose[s] velocity as a function of wall thickness,” and that doing so “would have predictably resulted in calculating a predicted value for the propagation velocity for a plurality of different wall thicknesses.” *Id.* at 22–23 (citing Ex. 1003, 2:60–64, 3:8–11, 1:8–11; Ex. 1002 ¶¶ 62–71).

On this record, and for purposes of institution, Petitioner’s showing is sufficient.

Claims 1 and 8⁸: *(iii) compute said wall thickness parameter by matching said actual value with said predicted value*

Petitioner relies on the Hunaidi Patent disclosing or rendering obvious both “measur[ing] the *actual* value of the propagation velocity” and “comput[ing] a *predicted* value . . . as a *function* of pipe thickness.” Pet. 23. Petitioner further relies on “[t]he Hunaidi Patent disclos[ing] [that] ‘[t]he pipe wall thickness is back-calculated by substituting in the above equation the measured value of the propagation velocity and values of all other pipe parameters which are usually known.’” *Id.* (quoting Ex. 1003, 3:8–11). Petitioner contends that the ’596 patent discloses “only one example of what ‘matching’ means” and that it is the same as that set forth in the Hunaidi Patent, “even down to using the same equation.” *Id.* at 24–25 (citing Ex 1001, code (57) (Abstract), 2:3–7, 3:46–56, 5:38, 6:1–8, 6:59–7:12, 9:28–31, 9:37–10:3; Ex. 1003, 2:57–6:7, claims 7 & 14; Ex. 1002 ¶¶ 49–50, 52–61).

Petitioner also contends, again, that “it would have been obvious to a [person of ordinary skill in the art] . . . that predicted propagation velocities may be graphed or tabulated for a variety of possible wall thicknesses” and that a benefit of this would be “that pipe wall thickness could . . . be determined easily by simply looking for the measured value for velocity on the y-axis [of a plot], and identifying the corresponding pipe wall thickness value on the x-axis.” *Id.* at 25–26 (citing Ex. 1003, 1:8–11, 3:8–11, claims 1 & 11; Ex. 1002 ¶¶ 49, 60, 62–70). Petitioner further contends that, as an

⁸ Claim 8 does not include “(iii)” in its recitation of this clause.

alternative to a graph, a person of ordinary skill in the art could create a “look-up table, with a column of predicted propagation velocities for several corresponding pipe-wall thicknesses. *Id.* at 26 (citing Ex. 1002 ¶¶ 65–68). Petitioner contends that a person of ordinary skill in the art “would have been motivated to create a plot or look up table because the same plot or look up table can be used repeatedly to quickly determine the wall thickness of different segments of pipe in the same system having the same constants” and that “it would be useful when checking for ‘corrosion’ of ‘municipal water pipes,’ which ‘have to be periodically inspected’ to determine ‘information about pipe wall thickness’ as was disclosed in the Hunaidi Patent.” *Id.* at 27 (citing Ex. 1002 ¶¶ 63–66, 70–71; Ex. 1003, 1:12–28).

On this record, and for purposes of institution, Petitioner’s showing is sufficient.

Conclusion

On this record, and in the absence of argument to the contrary by Patent Owner, we find Petitioner’s contentions that the Hunaidi Patent renders claims 1 and 8 obvious well-supported. Petitioner has directed us to portions of the Hunaidi Patent that teach or suggest all of the limitations in claims 1 and 8, and has provided a sufficiently persuasive reason why a person of ordinary skill in the art would have had reason to modify the disclosed apparatus and method to arrive at the subject matter of both independent claims. Thus, we are persuaded Petitioner has established a reasonable likelihood of prevailing on this challenge with respect to both claim 1 and claim 8.

Having determined that Petitioner demonstrates a reasonable likelihood of success in proving that at least one claim of the ’596 patent is unpatentable, the statutory threshold for instituting trial as to all challenged

claims on all grounds has been met. *See SAS Inst. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018); 37 C.F.R. § 42.108(a).

We offer the following views on other claims subject to this ground and on the remaining grounds for the parties’ consideration.

3. *Claims 2–7*

Petitioner contends that the additional limitations of claims 2–7 are taught or suggested by the Hunaidi Patent. Pet. 27–35.

On this record, Petitioner’s unrebutted contentions and positions as to claims 2–7 appear reasonably well-founded.

E. Asserted Obviousness over the Hunaidi Patent and the Hunaidi Article

Petitioner challenges claims 1–11 as unpatentable for obviousness over the combination of the Hunaidi Patent and the Hunaidi Article. Pet. 35–48.

1. *Printed Publication Status of the Hunaidi Article*

In an *inter partes* review, the petitioner bears the burden of establishing by a preponderance of the evidence that a particular document is a printed publication. *Nobel Biocare Servs. AG v. Intradent USA, Inc.*, 903 F.3d 1365, 1375 (Fed. Cir. 2018) (citing *Medtronic, Inc. v. Barry*, 891 F.3d 1368, 1380 (Fed. Cir. 2018)). Whether a reference qualifies as a “printed publication” is a legal conclusion based on underlying factual findings, including whether the reference was publicly accessible. *Id.*; see also *In re Wyer*, 655 F.2d 221, 227 (CCPA 1981) (a party asserting a reference as a prior art printed publication should provide sufficient proof of accessibility).

Petitioner contends that the Hunaidi Article is prior art under 35 U.S.C. § 102(a) and (b). Pet. 35. Petitioner fails, however, to set forth

any basis for the document to be a printed publication, that is, for its public accessibility. *See* Pet. Similarly, there is no testimony by Dr. Wilkens relevant to this issue. *See* Ex. 1002. Further, on this record, there is neither argument nor testimony as to the authenticity of what Petitioner has filed as the Hunaidi Article (Exhibit 1004).

2. *Overview of the Hunaidi Article (Ex. 1004)*

The Hunaidi Article is titled “Acoustic methods for locating leaks in municipal water pipe networks” and “introduces a new low-cost and easy-to-use system” to locate leaks. Ex. 1004, 2 (Title, Abstract). The Hunaidi Article discloses the system uses acoustic sensors to obtain signals that are wirelessly transmitted to leak noise correlators (microprocessor-based devices) that then determine the location of a leak based on the difference in time signals are received, the propagation velocity of leak noise in the pipe(s), and the distance between sensing points. *Id.* at 3–4.

3. *Motivation to Combine*

Petitioner provides only a limited basis for a person of ordinary skill in the art having a motivation to combine the teachings of the Hunaidi Patent and the Hunaidi Article. The clearest expression of a motivation to combine set forth in association with the ground, as applied to the independent claims, is that “a [person of ordinary skill in the art] would have been guided to look at leak detection systems, such as that disclosed in the Hunaidi Article,” because “[t]he Hunaidi Patent explains that ‘[t]he proposed method is easy to implement, for example, in conjunction with routine leak detection surveys.’” Pet. 38 (citing Ex. 1003, 3:35–36; Ex. 1004, Abstract, 7; Ex. 1002 ¶ 77). The difficulty with this is that the Hunaidi Patent itself already discloses what appears to be routine leak detection surveys, and it is thus not apparent what benefit would be obtained by this combination to

motivate the skilled artisan to combine the teachings. *Cf. Belden v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.”). As to further reasons set forth for the combination, as applied to claims 1 and 8, these are grounded on shortcomings in “the Hunaidi Article . . . not disclos[ing] an equation for velocity” or go to the obviousness of modifications to the Hunaidi Patent itself independent of the Hunaidi Article’s teachings. *Id.* at 38–40 (citing Ex. 1001, 7:1–12; Ex. 1002 ¶¶ 63–71, 80–86; Ex. 1003, 2:57–3:11, 1:8–11, claims 1& 11).

Petitioner also sets forth contentions as to certain dependent claims, *i.e.*, claims 3, 6, 7, 9–11, that relate to varying degrees to the potential motivation for the combination. Pet. 40–48. The clearest of these contentions relates to claim 10, depending from claim 8, that adds “instructions to cause said computer to display an input screen for accepting inputs relating to known pipe parameters for use in the computation.” *Id.* at 46–47 (addressing “[t]he Hunaidi Article disclos[ing] that the computer is instructed to display an input screen, . . . for accepting inputs relating to known pipe parameters for use in the computation” and that “[i]t would have been obvious to a [person of ordinary skill in the art] to cause the computer (PC 20) of the Hunaidi Patent to display an input screen . . . such as in the Hunaidi Article” because “[d]isplaying an input screen for accepting inputs would be beneficial to facilitate the system of the Hunaidi Patent.”) (citing Ex. 1004, 7; Ex. 1002 ¶¶ 98–99).

4. *Independent Claims 1 and 8*

Petitioner relies on the Hunaidi Patent as set forth above (*see* Pet. 35–37, 40), relying additionally on the Hunaidi Article for teachings relevant to

the step of “comput[ing] a corresponding predicted value . . .” (*id.* at 37–40). In particular, Petitioner relies on the Hunaidi Article’s disclosure regarding LeakFinderRT and its use to identify leaks using what appears to be the same method as disclosed in the Hunaidi Patent. *Id.* at 37–38 (quoting Ex. 1004, 12). As noted by Petitioner, however, the Hunaidi Article does not disclose an equation for velocity and Petitioner relies on the Hunaidi Patent for the equation (*id.* at 38–39), and on the equation being well-known in the art (*id.* at 39).

On this record, Petitioner’s unrebutted contentions and positions as to what the Hunaidi Article discloses appears reasonably well supported. Nonetheless, there are apparent issues with this ground, as discussed above, particularly as to whether the Hunaidi Article is sufficiently established as a printed publication.

5. *Claims 2–7 and 9–11*

Petitioner contends that the additional limitations of claims 2–7 and 9–11 are taught or suggested by the combination of the Hunaidi Patent and the Hunaidi Article. Pet. 40–48.

On this record, Petitioner’s unrebutted contentions and positions as to claims 2–7 and 9–11 appear reasonably well-founded, but, as discussed above, there are apparent issues with this ground.

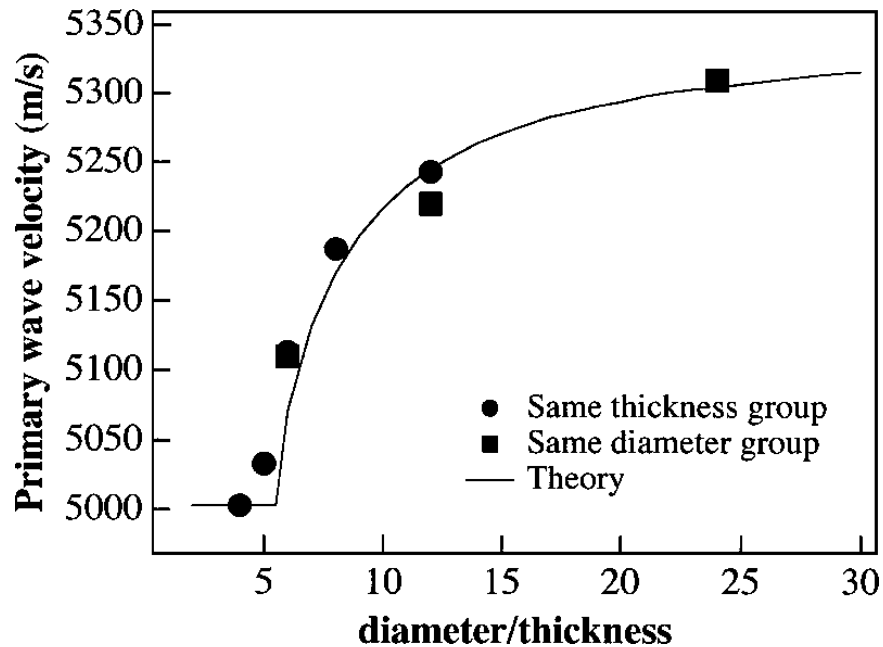
F. *Asserted Obviousness over the Hunaidi Patent and Nishino*

Petitioner challenges claims 1–8 as unpatentable for obviousness over the combination of the Hunaidi Patent and Nishino. Pet. 48–54.

1. *Overview of Nishino (Ex. 1005)*

Nishino is titled “Estimating the diameter/thickness of a pipe using the primary wave velocity of a hollow cylindrical wave” and is directed to “[a] method for measuring the diameter/thickness (d/t) of a pipe using a

characteristic of a hollow cylindrical guided wave.” Ex. 1005, 2 (Title, Abstract). Nishino discloses “the primary wave velocity as a function of d/t ” in its Figure 4, reproduced below.



Ex. 1005, 3–4 (Fig. 4 (depicting primary wave velocity as a function of pipe diameter/thickness)). The plot has “diameter/thickness” as the x-axis and “primary wave velocity (m/s)” as the y-axis and includes both plotted values within the “same thickness group” and the “same diameter group,” with points from both groups falling on the same theoretical plot. *Id.*

2. Independent Claims 1 and 8

Petitioner relies on the Hunaidi Patent as set forth above (see Pet. 49–50, 53), relying additionally on Nishino for “disclos[ing] computing a predicted value for of [sic] a primary wave velocity (m/s) for a plurality of different values for a wall thickness parameter (e.g., diameter/thickness)” in its Figure 4 (*id.* at 50–51) and for “disclos[ing] that the ratio of diameter to thickness ‘ d/t ’ could be estimated by measuring the primary wave velocity of

the [hollow cylindrical guided wave]’ based on the results of Figure 4” (*id.* at 53–54).

Petitioner relies on Nishino’s computing of a predicted value of primary wave velocity for the diameter/thickness parameter as rendering it obvious to a [person of ordinary skill in the art] to plug in the known constants for the pipe and fluid medium and plot a curve or create a look up table from the equation from the equation in column 2, lines 60–64 of the Hunaidi Patent, which represents velocity as a function of wall thickness.

Id. at 51–52 (citing Ex. 1003, 2:57–3:16; Ex. 1002 ¶¶ 102–105).

Petitioner relies on Nishino’s Figure 4, “a graph matching theoretically calculated (predicted) values and experimentally confirmed (actual) values of primary wave velocity as a function of the ratio of diameter/thickness (thickness parameter),” informing a person of ordinary skill in the art. *Id.* at 53 (citing Ex. 1005, 3–4). What the person of ordinary skill in the art is to do with the disclosure, however, is less clearly set forth, as Petitioner fails to address that Nishino plots primary wave velocity as a function of pipe diameter/thickness, rather than simply thickness, in contending that

a [person of ordinary skill in the art] would have understood that predicting a thickness parameter, such as the diameter/thickness ratio, could easily and accurately be done by graphing the equation of the Hunaidi Patent, and matching the actual measured value for velocity with the location on the curve (predicted value) with the same value for the predicted velocity, and then simply looking at what the corresponding thickness parameter value is for the curve at the location.

Pet. 54 (citing Ex. 1002 ¶¶ 101–105). While it would make sense to graph the equation of the Hunaidi Patent with velocity as a function of thickness, which is what Petitioner set forth for the plot or table of calculated values,

the only function explicitly set forth in discussing the matching step is “a thickness parameter, such as the diameter/thickness ratio.” *Id.* at 54.

3. *Claims 2–7*

Petitioner simply incorporates its “discussion of the Hunaidi Patent’s disclosure of claims 2–7” without elaboration. Pet. 54.

We offer no further comment.

G. Asserted Obviousness over the Hunaidi Patent, Nishino, and the Hunaidi Article

Petitioner challenges claims 3, 6, and 9–11 as unpatentable for obviousness over the combination of the Hunaidi Patent, Nishino, and the Hunaidi Article. Pet. 54–55.

Petitioner simply incorporates the discussions of prior discussed grounds and applies them to the various claims without elaboration. *Id.*

We offer no further comment.

H. Asserted Obviousness over the Hunaidi Patent and Brophy

Petitioner challenges claims 1–8 as unpatentable for obviousness over the combination of the Hunaidi Patent and Brophy. Pet. 55–63.

1. *Overview of Brophy (Ex. 1007)*

Brophy is titled “Method for Determining Average Wall Thickness for Pipes and Tubes Using Guided Waves” and is directed to “determining changes in the average wall thickness or the mean radius of a pipe or tube using ultrasonic and/or magnetostrictive wave probes.” Ex. 1007, codes (54), (57). The disclosed “method examines certain wave propagation modes and identifies a cut-off frequency that is characteristic for a particular wall thickness or tube diameter” allowing “rapid and accurate inspection of a length of pipe or tube from a single location on the inside diameter of the pipe.” *Id.* at code (57); *see id.* at 1:7–10, 2:44–62. Brophy discloses that the

method “permits a comparison of data gathered with similar data for the structure in its original condition,” and, thus, “provides a mechanism for determining the remaining service life for . . . pipes and tubes.” *Id.* at code (57). Brophy also discloses measuring wave velocity at two discrete frequencies to obtain a ratio characteristic of the mean radius and that “[b]y comparing the velocity ratio from a tube with known dimensions with the velocity ratio from a tube with an undetermined amount of all loss, the mean radius of the tube can be calculated.” *Id.* at 4:60–66.

2. *Independent Claims 1 and 8*

Petitioner relies on the Hunaidi Patent as set forth above (see Pet. 54–57, 59), relying additionally on Brophy as “disclos[ing] that it is desirable to calculate predicted values for velocity, such as velocities from an uncorroded tube with known geometries and wall thickness, so that the predicted value can be compared to the actual values of velocity for a corroded pipe.” (*id.* at 57 (citing Ex. 1007, 4:58–67, 2:1–22, 3:5–38)) and as “disclos[ing] matching the ratio of predicted velocities (at two discrete frequencies), for an uncorroded pipe of known wall thickness (known dimensions) to the ratio of actual velocities . . . measured in a corroded pipe of unknown wall thickness, to determine ‘the mean radius of the tube,’ and ‘the average wall loss’” (*id.* at 60 (citing Ex. 1007, 4:48–67, 3:5058, 3:33–38, Claim 1)).

Petitioner contends that,

Based on the disclosure of Brophy, it would have been obvious to a [person of ordinary skill in the art] to plug in the known constants for the pipe and fluid medium into the equation in column 2, lines 60–64 of the Hunaidi Patent . . . and calculate a predicted value for the propagation velocity . . . [for a tube of known dimensions] so that the predicted velocity can

be compared to the actual measured velocity of a corroded tube to determine the average wall loss of the corroded tube. *Id.* at 58 (citing Ex. 1002 ¶¶ 107–110, 62–71). Petitioner also contends that “Brophy explains that it is beneficial to non-destructive thickness testing to calculate a theoretical velocity for an uncorroded reference pipe having known thickness and geometries.” *Id.* at 58–59 (citing Ex. 1007, 1:7–10, 4:58–67, 2:1–22, 2:44–62, 3:35–38).

Petitioner and Dr. Wilkens rely on Brophy disclosing the calculation of predicted values for velocities in pipes or tubes with known geometry and wall thickness. Pet. 57 (stating Brophy “disclosed that it is desirable to calculate predicted values for velocity”); Ex. 1002 ¶ 106 (“Brophy explains that it is desirable to calculate predicted values for velocities.”). Petitioner relies on this disclosure as supporting the obviousness of calculating theoretical values by plugging in known constants for the pipe and fluid medium into the Hunaidi Patent’s equation. Pet. 58.

It is not apparent that Brophy teaches calculating predicted velocities as Petitioner and Dr. Wilkens both contend. Rather than teaching *calculating* predicted velocities, Brophy explicitly sets forth *measuring* velocities (velocity ratios) of reference pipes or tubes with known dimensions. Ex. 1007, 4:58–67. Neither Petitioner nor Dr. Wilkens identify any disclosure in Brophy that discloses calculating predicted velocity values rather than measuring them. Further, neither Petitioner nor Dr. Wilkens explain why it would have been obvious to calculate predicted values rather than measure values in reference pipes of known dimensions, as both start from the position that Brophy teaches that it is desirable to calculate predicted values for velocity.

Petitioner and Dr. Wilkens, likewise, rely on Brophy matching a ratio of predicted velocities (at two discrete frequencies) for a pipe of known wall thickness to the ratio of actual velocities (at the same two discrete frequencies). Pet. 60–63. The issue again is that Brophy does not reasonably disclose calculating predicted velocities, but instead teaches measuring velocities in reference pipes. *See* Ex. 1007, 4:58–67. Accordingly, it is not clear, on this record, what basis can be found in Brophy for calculating a predicted velocity based on a theoretical model. Further, given the apparent mismatch between what Brophy teaches and what both Petitioner and Dr. Wilkens rely on Brophy teaching, there may be issues with respect to the motivation to combine the teachings of the Hunaidi Patent and Brophy.

3. *Claims 2–7*

Petitioner simply incorporates its “discussion of the Hunaidi Patent’s disclosure of claims 2–7” without elaboration. Pet. 63.

We offer no further comment.

I. Asserted Obviousness over the Hunaidi Patent, Brophy, and the Hunaidi Article

Petitioner challenges claims 3, 6, and 9–11 as unpatentable for obviousness over the combination of the Hunaidi Patent, Brophy, and the Hunaidi Article. Pet. 64.

Petitioner simply incorporates the discussions of prior discussed grounds and applies them to the various claims without elaboration. *Id.*

We offer no further comment.

III. CONCLUSION

Based on the arguments and evidence before us, we determine Petitioner demonstrates a reasonable likelihood of prevailing in showing that

at least one claim of the '596 patent is unpatentable. Accordingly, we institute an *inter partes* review on all the challenged claims and all of the grounds presented in the Petition. See 37 C.F.R. § 42.108(a). At this stage of the proceeding, we have not made a final determination as to the patentability of the challenged claims. Our final decision will be based on the record as fully developed during trial.

IV. ORDER

Accordingly, it is:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review is hereby instituted as to claims 1–11 of the '596 patent with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4(b), notice is hereby given of the institution of a trial commencing on the entry date of this decision.

IPR2022-00153
Patent 7,475,596 B2

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