

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WEATHERFORD U.S., L.P.
Petitioner

v.

HALLIBURTON ENERGY SERVICES, INC.,
Patent Owner

Case No. IPR2024-00990
U.S. Patent 11,333,007

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Submitted Electronically

**PATENT OWNER'S RESPONSE
UNDER 37 C.F.R. § 42.120**

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Patent Owner's Exhibits	
No.	Exhibit Description
2001	Deposition Transcript of Dr. Michael R. Chambers re: IPR2024-00990 (February 21, 2025)
2002	Declaration of Robert A. Durham
2003	Curriculum Vitae of Robert A. Durham
2004	Second Declaration of Dr. Robert Durham
2005	U.S. Provisional Application No. 62/688,813
2006	Bourgoyne, Adam T., Jr., Keith K. Millheim, Martin E. Chenevert, and F.S. Young, Jr., <i>Applied Drilling Engineering</i> , Society of Petroleum Engineers (1986).
2007	Staff of Royal Dutch / Shell Group of Companies, <i>The Petroleum Handbook</i> , (1983).
2008	Rahman, S. S. and G. V. Chilingarian, <i>Casing design-theory and practice</i> (1995).
2009	IEEE RP 1017, "IEEE Recommended Practice for Field Testing Electric Submersible Pump Cable" (2004).
2010	Conaway, Charles F, <i>The Petroleum Industry: A Nontechnical Guide</i> . Pennwell Books (1999).
2011	Braek, A. M., R. A. Almehaideb, and R. Hughes, <i>Application of Eos to Optimize the Design of an Early Production Scheme of an Onshore Oil Field in Abu Dhabi</i> , Abu Dhabi International Petroleum Exhibition and Conference (1998).

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I. INTRODUCTION

Halliburton Energy Services, Inc. (“Patent Owner”) respectfully submits this Response in accordance with 37 C.F.R. § 42.120, responding to the Petition for *Inter Partes* Review (the “Petition”) filed by Weatherford U.S., L.P. (“Petitioner”) challenging Claims 1-12 and 14-23 (the “challenged claims”) of U.S. Patent No. 11,333,007 (the “’007 Patent”) and the Board’s Decision Granting Institution of *Inter Partes* Review (“ID”). The Petition’s grounds are deficient and should be rejected by the Board.

First, Ground 1 fails because Petitioner has not shown that challenged claims 1-10 would have been obvious. The Petition fails to show that the combination of cited references renders obvious claim 1’s “the transport tube of the first sand screen assembly has a first wall thickness and the transport tube of the second sand screen assembly has a second wall thickness, the first wall thickness being greater than the second wall thickness.”

Second, Ground 1 also fails as to dependent claims 2, 4, and 5 for additional reasons. The Petition fails to show that the combination of cited references renders obvious claim 2 or claim 4 limitations relating to the number and cross-sectional flow area of packing tube nozzles. The Petition also fails to show that the combination of cited references renders obvious claim 5’s requirement that “the cross-sectional flow areas of the passageway in the first and second transport tubes

is the same.”

Third, Ground 2 fails because Petitioner has not shown that challenged claims 14-20 would have been obvious. The Petition fails to show that the combination of cited references renders obvious claim 14’s step of “determining a shunt tube system operating pressure associated with the distal end of the production zone and selecting a low-pressure shunt tube system based on the distal end determined pressure.”

And finally, Grounds 3-4 fails as to claims 21-23. The Petition fails to show that the combination of cited references renders obvious claim 21’s “the transport tube of the first sand screen assembly is formed of a first material and the transport tube of the second sand screen assembly is formed of a second material, the first material having a greater tensile strength than the second material.”

Petitioner therefore has not shown by a preponderance of the evidence that claims 1-10 or 14-23 are unpatentable. Accordingly, the Board should uphold the validity of challenged claims 1-10 and 14-23.

II. LEVEL OF ORDINARY SKILL IN THE ART

For purposes of this Response, PO applies the same level of skill proposed by Petitioner. Pet., p.31; EX2002, §VIII.

III. CLAIM CONSTRUCTION

For purposes of this Response, Patent Owner interprets the claims “in accordance with the ordinary and customary meaning” as understood by a POSITA. 37 C.F.R. §42.100(b); EX2002, §X.

IV. OVERVIEW OF THE '007 PATENT

A. The '007 Patent

The '007 Patent, entitled “Multiple Shunt Pressure Assembly for Gravel Packing,” was issued by the USPTO on May 17, 2022. Ex. 1001 at (45). The '007 Patent relates to fracturing operations in the oil and gas industry and, in particular, discloses “shunt tube systems utilized in the sand screen assemblies” for “wellbore gravel packing.” EX1001, 1:15-20. The patent explains that gravel packing in an oil or gas well may be used to prevent formation sand from being “swept into the flow path of the production fluid” during production. EX1001, 1:24-47. A problem that may arise during gravel packing is “leak-off” in the gravel pack, in which “premature loss of the [gravel] carrier fluid into the formation” may result in “incomplete packing,” or the “formation of sand bridges” in the gravel pack. *Id.*, 1:44-53. The '007 Patent explains that “shunt tubes” in a sand screen structure may “operate[] to permit the inflowing packing sand/gel slurry to bypass any sand bridges” and complete the gravel pack. *Id.*, 1:54-67.

The '007 Patent also explains that “where production zones are elongated,” multiple “lower completion assemblies” may be needed to form a string from the

production zone’s “upstream end to the downstream end,” and “relatively high pressures must be applied to the carrier fluid.” Ex. 1001, 2:1-9. The ’007 Patent notes that historically, “each individual lower completion assembly” is “designed to withstand the high delivery pressures at the upstream end” of the string. *Id.*, 2:9-14.

B. Priority Date

PCT Patent Application No. PCT/US2019/024626 leading to the ’007 Patent was filed on March 28, 2019. Ex. 1001 at (22), (86). The ’007 Patent claimed priority to provisional application No. 62/688,813 filed on June 22, 2018. Ex. 1001 at (60). Petitioner applies the provisional filing date of June 22, 2018 as the priority date. Pet., pp.30-31. Patent Owner does not dispute this priority date.

C. Prosecution History

The Examiner issued an Office Action on July 6, 2021, rejecting all claims under 35 U.S.C. §103 and §112. Ex. 1002, 262-84. The Examiner rejected claims 1-23 as obvious. *Id.* at 269-84. In a response dated October 6, 2021, Applicant argued against these rejections and amended the claims, arguing that the combination does not teach changing characteristics of the shunt tube assemblies along the length of a production zone. *Id.* at 564-74.

The Examiner issued another Office Action on October 21, 2021, allowing claims 1-7, 9-15, and 17-24, and rejecting claim 8 under 35 U.S.C. §112. *Id.* at 583-92. In a response dated December 8, 2021, Applicant amended claim 8 to address

the §112 rejection. *Id.* at 608-15. A Notice of Allowability was issued on January 21, 2022. *Id.* at 622-24.

V. OVERVIEW OF PRINCIPAL CITED REFERENCES

A. *Yeh* (Ex. 1005)

U.S. Patent No. 9,797,226 to Yeh et al. (“*Yeh*”) describes a “crossover joint for connecting eccentric flow paths to concentric flow paths.” Ex. 1005 at (54). *Yeh* explains that its “crossover joint” may be used to connect sand screens to one another or to packers. *Id.*, 4:8-14. *Yeh* describes considerations in designing the crossover joint, which include minimizing curvature, providing mechanical integrity, limiting “outer diameter” of the tool, and “maximizing inner diameter of the primary flow path.” *Id.*, 26:57-64, 28:25-30.

As relied on in the Petition, *Yeh* describes an embodiment containing a concentric screen upstream and an eccentric screen downstream. Ex. 1005, 30:13-39. For this embodiment, *Yeh* explains that “concentric screens” may be preferred “when gravel packing long intervals.” Ex. 1005, 30:15-17. *Yeh* describes how “concentric screens are capable of gravel packing 5,000 feet, compared to 3,000 feet with the commercial eccentric screens.” Ex. 1005, 30:17-20.

Yeh further explains that eccentric screens may be used downstream, below the concentric screens, to “reduce the overall friction or extend the maximum gravel packing length of the completion.” *Id.*, 24:54-60. *Yeh* also explains that using “more

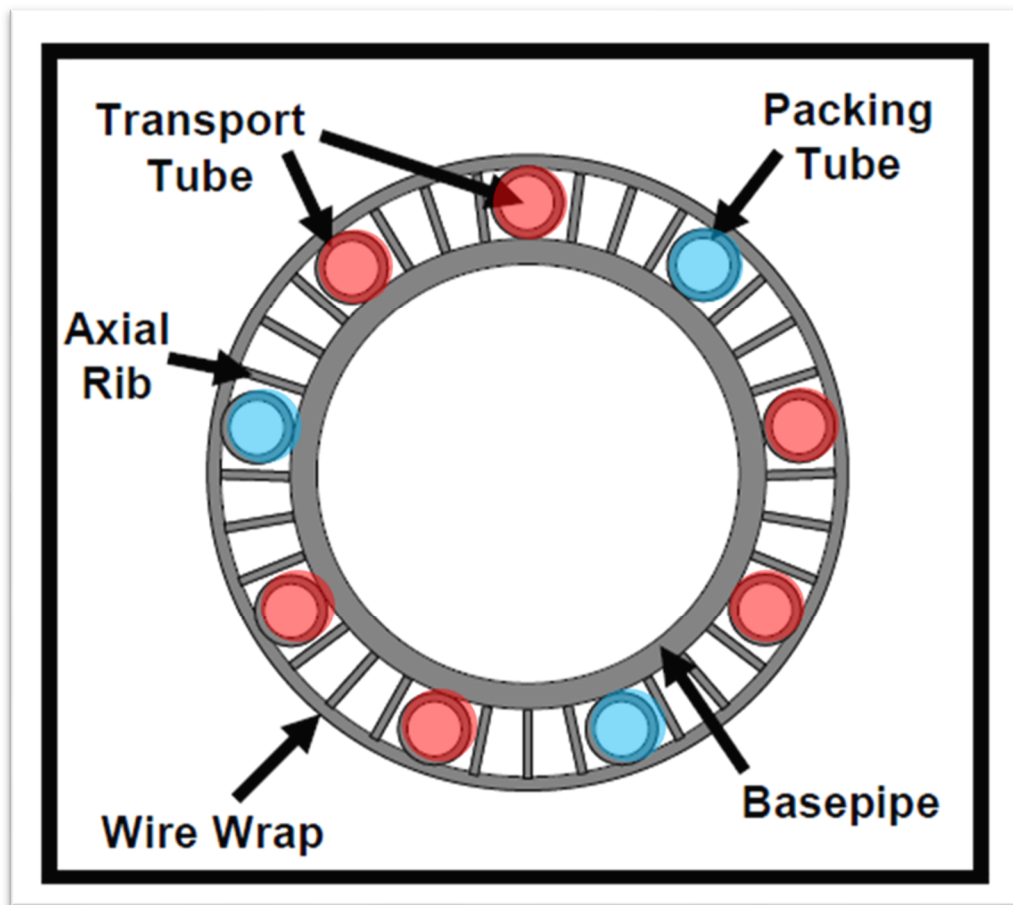
readily available” and “less expensive eccentric screens” downstream, instead of “more complex” concentric screens, may “reduce the overall cost of completion.” Ex. 1006, 30:20-33. Accordingly, *Yeh* teaches use of eccentric screens to reduce expense, provide greater availability, and reduce friction in a downstream well interval. Ex. 2002, §VII.A.

Yeh does not describe improvements on existing sand screens or significant factors in sand screen design, and instead focuses on connecting sand screens and packers together via its “crossover tool.” Ex. 2002, §VII.A.

B. *Yeh2* (Ex. 1006)

IPTC 12549 (“*Yeh2*”), describes a “multiple-shunt manifold” gravel packing system “for extreme length.” Ex. 1006, p.4. *Yeh2* describes a concentric screen design, named “Alternate Path technology” (APT), for gravel packing long intervals of 5,000 feet. Ex. 1006, p.6, Fig. 10. *Yeh* explains that longer wells, such as a “5,000 ft or longer,” require higher working pressures. Ex. 1006, pp.3 (explaining “higher working pressures demanded at extreme lengths”), 5. *Yeh* informs the POSITA that “[b]urst strength of shunt tubes must therefore be capable of accommodating this high hydraulic pressure.” *Id.*, p.5. *Yeh2* thus teaches a POSITA to rate shunt tubes to withstand the pressure required at the heel of the production interval. Ex. 2002, §VII.B.

The concentric screen of *Yeh2* achieves “extreme length” gravel packing by implementing round shunt tubes in a 6x3 configuration, along with manifolds and closed-ended packing tubes. Ex. 1006, Figs. 9-10. As shown below, *Yeh2*’s concentric screen has six transport tubes (annotated in red) and three packing tubes (annotated in blue):



Ex. 1006, Fig. 10. *Yeh2*’s concentric screen uses round transport and packing tubes with a 16 mm inner diameter. *Id.*, p.4. *Yeh2* teaches that “round shunt tubes” “increase the mechanical strength and pressure integrity required for extreme length gravel packing.” *Id.*, p.4.

C. Jones (Ex. 1007)

U.S. Patent No. 4,945,991 to Jones (“*Jones*”) describes a “method for gravel packing wells.” Ex. 1007 at [54]. *Jones* issued on August 7, 1990. *Jones* describes a concentric sand screen assembly with two round packing tubes. *Id.*, Fig. 4. *Jones* discloses gravel packing through a “conduit . . . with a plurality of openings or perforations [] at preselected intervals.” Ex. 1007, 3:55-68. *Jones* explains that the conduit “may be made of any pressure-resistant material,” such as “stainless steel.” *Id.*, 4:11-13.

D. Jones2 (Ex. 1008)

U.S. Patent No. 5,113,935 to Jones (“*Jones2*”) describes “gravel packing of wells.” *Jones2* issued on May 19, 1992. *Jones2* details an apparatus that “provides a good distribution of gravel” throughout the gravel pack. *Id.*, 1:5-10. *Jones2* refers back to *Jones* and states that it improves on *Jones* by including “shunt means” (including various conduits) “which can selectively deliver the gravel slurry to different levels of the interval during the gravel packing operation.” *Id.*, 2:24-30.

VI. PETITIONER HAS NOT ESTABLISHED THE CHALLENGED CLAIMS ARE OBVIOUS

A. Legal Requirements of a Petition Asserting Obviousness

Petitioner bears the burden of proving unpatentability by a preponderance of the evidence on the grounds asserted in the Petition. 35 U.S.C. §314(e). The Petition must describe the grounds with “particularity.” 35 U.S.C. §312(a)(3); *Intelligent*

Bio-Systems, Inc. v. Illumina Cambridge Ltd., 821 F.3d 1359, 1369 (Fed. Cir. 2016) (“It is of the utmost importance that petitioners ... adhere to the requirement that the initial petition identify ‘with particularity’ the ‘evidence that supports the grounds for the challenge to each claim.’” (quoting 35 U.S.C. §312(a)(3))). Specifically, the Petition “must specify where each element of the claim is found in the prior art patents or printed publications relied upon.” 37 C.F.R. §42.104(b)(4). Petitioner must therefore show that “the structural features of [the challenged claims] were known prior art elements.” *K/S HIMPP v. Hear-Wear Technologies, LLC*, 751 F.3d 1362, 1365-66 (Fed. Cir. 2014); *Personal Web Techs., LLC v. Apple*, 848 F.3d 987, 991 (Fed. Cir. 2017). Under 35 U.S.C. §103, Petitioner must prove the claimed subject matter would have been obvious to a POSITA at the time of the invention. In considering obviousness, the Board must determine the scope and content of the prior art and differences between the prior art and the claims and the level of ordinary skill in the pertinent art. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966).

A claim limitation must be proven to be in the prior art; it cannot be proven by conclusory testimony unsupported by concrete evidence. *See Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1363-66 (Fed. Cir. 2016) (reversing the Board’s obviousness determination, which relied on “common sense,” because the petitioner’s expert declaration lacked “evidence and a reasoned explanation”). Petitioner must offer “a sufficient explanation of how the references may be

combined, from the perspective of one with ordinary skill in the art, to arrive at the claimed invention, and why the proffered combination accounts for all the features of each claim.” *Dominion Dealer Sols., LLC v. AutoAlert, Inc.*, IPR2013-00223, Paper 9 at 19 (P.T.A.B. Aug. 15, 2013); *see also Arendi*, 832 F.3d at 1362 (“[O]ur cases repeatedly warn that references to ‘common sense’—whether to supply a motivation to combine or a missing limitation—cannot be used as a wholesale substitute for reasoned analysis and evidentiary support”). “[A] clear, evidence-supported account of the contemplated workings of the combination is a prerequisite” to concluding “that a relevant skilled artisan would have been motivated to make the combination and reasonably expect success in doing so.” *Personal Web Techs. LLC*, 848 F.3d at 994. Moreover, “[o]bviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor.” *Para-Ordnance Mfg., Inc. v. SGS Importers Int’l, Inc.*, 73 F.3d 1085, 1087 (Fed. Cir. 1995); *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984).

B. Ground 1 Fails as to Claims 1-10 because the *Yeh/Yeh2* Combination Does Not Disclose or Render Obvious Each Element of Independent Claim 1

The *Yeh/Yeh2* combination of Ground 1 fails to render obvious claim 1. First, nothing in *Yeh* or *Yeh2* teaches an upstream transport tube having a greater wall thickness than a downstream transport tube, as required by claim 1. Second, *Yeh* and

Yeh2 actually teach a system in which the upstream transport tube wall thickness is less than the downstream transport tube wall thickness, and both references teach away from modifying shunt tube wall thickness in a manner that renders the upstream wall thickness greater than the downstream wall thickness. Third, Petitioner argues that using a greater transport tube wall thickness upstream would be obvious to try, but Petitioner fails to meet the legal requirements for showing obviousness based on improvements to the art being obvious to try. Fourth, the *Yeh/Yeh2* combination teaches a different solution for obtaining high pressure transport tubes—concentric screens—that directs a POSITA away from increasing tube wall thickness to obtain higher pressure performance. And finally, Petitioner’s arguments for a greater upstream transport tube thickness rely on hindsight that contradicts the clear teachings of *Yeh* and *Yeh2*.

- 1. The Combination of *Yeh* and *Yeh2* Does Not Disclose or Render Obvious Claim Element 1[e]: “the transport tube of the first sand screen assembly has a first wall thickness and the transport tube of the second sand screen assembly has a second wall thickness, the first wall thickness being greater than the second wall thickness”**

Petitioner argues in Ground 1 that a POSITA would have used a concentric sand screen assembly¹ upstream and an eccentric sand screen assembly downstream.

¹ For brevity, PO may refer to sand screen assemblies herein as “sand screens” or “screens.”

Petition, p.32-34 (describing *Yeh*'s "concentric screen" as "the first sand screen assembly" and *Yeh*'s "eccentric screen" as "the second sand screen assembly" in claim 1); Ex. 2001, 25:2-26:1. This is the consistent foundation for every ground in the Petition. *Id.*, p.32-34, 59-60 (referring back to arguments for claim 1), 66-67, 76-77 (referring back to arguments for claim 1). According to the Petition, this combination teaches an upstream concentric sand screen (mapped to the claimed "first sand screen assembly") with a higher pressure rating than the downstream eccentric sand screen (mapped to the claimed "second sand screen assembly"). Pet., p.41; *see also id.*, p.60. The Petition then assumes that a POSITA would achieve a higher pressure rating by increasing shunt tube wall thickness in the upstream sand screen. Pet. p.42.

But this assumption begs the question and ignores the teachings of Petitioner's references. Neither *Yeh* or *Yeh2* teaches or suggests an upstream sand screen having a greater transport tube wall thickness than a downstream sand screen. Ex. 2002, §XI.A.1. The Petition relies on a single disclosure from *Yeh* as teaching a POSITA to use a greater shunt tube wall thickness, but Petitioner misinterprets *Yeh*'s teachings on wall thickness. Specifically, in a section discussion its crossover joint, *Yeh* states:

In order to maintain the mechanical integrity (that is, to stay within the burst, bending, and collapse ratings) of the secondary flow paths, a certain surrounding wall thickness is required. This, in turn, limits the inside diameter of the crossover joint.

Ex. 1005, 28:20-24. Petitioner relies on this disclosure as teaching a POSITA “that a higher-pressure shunt tube assembly necessitated greater wall thickness.” Petition, p.42; *see also* Ex. 1003, ¶297. But Petitioner’s hindsight ignores what *Yeh* actually discloses: ***Yeh addresses wall thickness of the crossover joint, not wall thickness of the shunt tubes.*** *Yeh* makes this statement about wall thickness in an embodiment describing its crossover joint and appropriate rates of curvature for the crossover joint, as illustrated in Figs. 10-11. Ex. 1005, 25:41-55, 26:57-28:8. *Yeh* explains that minimizing curvature in the crossover joint is preferred to “ease downhole tool pass-through, reduce torque and drag, minimize erosion by particle flow, and minimize flow friction.” Ex. 1005, 26:61-64. *Yeh* further explains that one “way to mitigate the curvature impact on the primary flow path is to increase the internal diameter of the crossover joint.” *Id.*, 28:5-8. Increasing the diameter of the primary flow path “eases the run of other downhole tools through the curved crossover joint.” *Id.*

In this embodiment, *Yeh* also describes its “crossover tool” as having a “wall 1010” that defines a primary flow path. Ex. 1005, 25:41-55, Fig. 10. And Figure 10 makes clear that wall 1010 contains *Yeh*’s secondary flow path 1020. *Id.*, Fig. 10. Only after this explanation—teaching a POSITA to minimize crossover curvature and increase the internal diameter of the primary flow path—does *Yeh* state that “a certain surrounding wall thickness is required.” Ex. 1005, 28:5-24. When *Yeh* explains that “a certain surrounding wall thickness is required,” *Yeh* refers to wall

1010 of the crossover joint, not wall thickness of the shunt tubes in the secondary flow path (i.e., shunt tubes). Ex. 2002, ¶¶88-91 (explaining that this disclosure of *Yeh* “is not addressing the relatively uniform wall thickness of the shunt tubes, but the variable wall thickness of the crossover joint”). *Yeh* explains that wall 1010 requires a certain thickness to place a limit on its teaching to increase the internal diameter of the crossover joint’s primary flow path. Ex. 2002, ¶91. And *Yeh* makes this abundantly clear in the following sentence: “[t]his, in turn, limits the inside diameter of the crossover joint.” Ex. 1005, 28:23-24.

A POSITA would have read these disclosures in the context of Figure 10 illustrating the crossover joint. As shown in Figure 10 (annotated in green and red below), requiring “a certain surrounding wall thickness” of wall 1010 “limits the inside diameter of the crossover joint”:

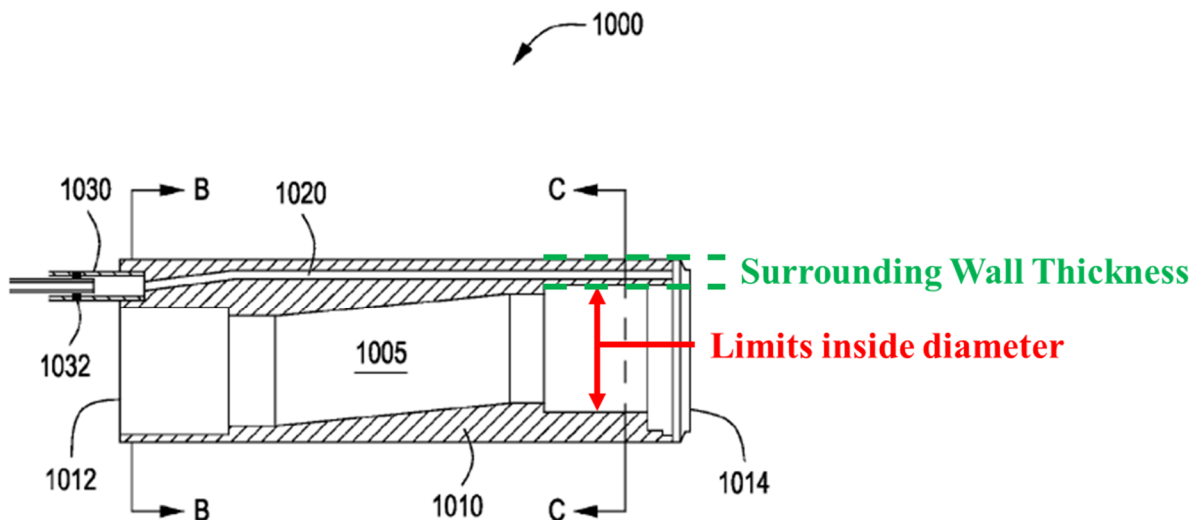


FIG. 10A

Ex. 1005, Fig. 10, 28:20-24. In sum, *Yeh* teaches a POSITA to maximize the primary flow path, but to maintain mechanical integrity of secondary flow paths. Ex. 2002, ¶¶91-92. That is *not* a teaching, as Petitioner suggests, to increase shunt tube wall thickness. *Cf.* Pet., p.42 (“From *Yeh*’s express disclosure that a ‘certain surrounding wall thickness is required’ . . . one of skill would have understood that a higher-pressure shunt tube assembly necessitated greater wall thickness.”). If anything, this disclosure in *Yeh* would teach a POSITA to limit space for shunt tubes because the primary flow path (including in the crossover joint) requires a certain inner diameter to run tools downhole and perform effective pumping operations by minimizing torque, drag, erosion, and friction. Ex. 2002, ¶91; Ex. 1005, 26:61-64.

When asked to address this disclosure, Petitioner’s expert confirmed his misunderstanding, stating that *Yeh* describes shunt tube wall thickness (Ex. 2001, 50:14-51:8 (claiming *Yeh* teaches “wall thickness is a controlling factor in shunt tube design”). But Mr. Chambers also admitted that “most of the time [*Yeh*’s] talking about the casing wall.” Ex. 2001, 51:17-52:12.

And not only does *Yeh* teach maximizing the inner diameter of wall 1010, it also teaches constraining outer diameter. *Yeh* explains that the crossover joint should, in addition to “maximizing inner diameter of the primary flow path,” have “an overall outer diameter that is less than or equal to the diameters of the adjacent wellbore tools.” Ex. 1005, 28:25-30. *Yeh* thus informs a POSITA that the secondary

flow paths (i.e., shunt tubes) must fit in a space constrained both by maximizing diameter of the primary flow path and limiting outer tool diameter to fit within adjacent tools. Ex. 2002, ¶¶88-92. *Yeh* offers a POSITA no guidance on shunt tube design, other than to maintain “mechanical integrity,” and *Yeh* makes clear that this mechanical integrity must be achieved in limited space. *Id.* Accordingly, a POSITA presented with the teachings of *Yeh* would have been motivated to maintain mechanical integrity of a secondary flow path in as small an area as possible. Ex. 2001, 58:19-59:10 (admitting that shunt tubes “have to fit within this confining area”); *see* Ex. 2002, §XI.A.1.

And *Yeh2* does not compensate for *Yeh*’s failure to render obvious greater wall thickness in an upstream sandscreen. Nowhere does *Yeh2* address wall thickness at all, let alone wall thickness of transport tubes for gravel packing. *See* Ex. 2002, ¶¶47-48, 109-110; *see generally* Ex. 1006. Nor does Petitioner rely on *Yeh2* for claim element 1[e]. Pet., p.41. Petitioner’s obviousness theory rests on a misreading of one disclosure in *Yeh* that actually teaches a POSITA to constrain shunt tube size, not to thicken the shunt tube wall.

- 2. Both *Yeh* and *Yeh2* Teach Away from “the transport tube of the first sand screen assembly has a first wall thickness and the transport tube of the second sand screen assembly has a second wall**

thickness, the first wall thickness being greater than the second wall thickness”

Not only does the *Yeh/Yeh2* combination not teach a POSITA to use a greater transport tube wall thickness upstream, it also teaches a POSITA to use a concentric screen upstream in a manner leading in the opposite direction from claim 1.

First, *Yeh* teaches a POSITA away from the invention of claim 1 by directing a POSITA to use concentric screens, with thinner walls, upstream. The Petition relies on *Yeh*’s disclosure of a concentric screen upstream and an eccentric screen downstream. Pet., p.33-34; Ex. 1005, 30:13-14, 30:20-25. And Petitioner’s expert, Mr. Chambers, admits that concentric screens (the upstream screen) had thinner transport tube walls than eccentric screens (the downstream screen). Ex. 1003, ¶162; Ex. 2002, ¶¶105-07. Mr. Chambers explains that walls of rectangular tubes used in eccentric screens were 0.095 inches thick, or 2.4 mm, while concentric designs had a 16 mm inner diameter and 20 mm outer diameter, corresponding to a 2 mm wall thickness. Ex. 1003, ¶162; Ex. 2002, ¶106. Mr. Chambers states conclusorily that an upstream concentric screen rated to higher pressure would have thicker shunt tube walls because “containing internal pressure within tubing required a certain wall thickness,” (Ex. 1003, ¶290-91), but the wall thickness required to contain pressure in concentric screens with smaller, round tubes is demonstrably less than the wall thickness required for eccentric screens using larger, rectangular tubes. Ex. 2002, ¶¶105-07.

Second, *Yeh2*, which also teaches a concentric screen, directed a POSITA to achieve higher pressure ratings by changing numerous design parameters other than shunt tube wall thickness. *Yeh2* taught to use concentric screens at higher pressures and “extreme lengths,” such as those described in *Yeh*. Ex. 1006, pp.3, 5. *Yeh2* further explains that its concentric screen is designed to withstand the pressure required at the heel of the production interval, not for lower pressures downstream. Ex. 1006, p.5 (“Burst strength of shunt tubes must therefore be capable of accommodating this high hydraulic pressure.”); Ex. 2002, ¶47. And reading *Yeh2*’s description of its concentric screen design, a POSITA would have understood that the concentric screen achieved those higher pressures and extreme lengths by:

- Reducing tube cross section (Ex. 1006, p.4 (noting tube size of “16 mm ID”));
- Changing tube shape, from rectangular to round (*Id.*, p.4 (“Round shunt tubes were chosen to increase . . . pressure integrity”));
- Increasing the number of transport tubes, from two to six (*Id.*);
- Increasing the number of packing tubes, from two to three (*Id.*);
- Using manifolds (*Id.*);
- Using closed-ended packing tubes (*Id.*).

See also Ex. 1006, Figs. 9-10, p.5 (explaining constraints of “wellbore dimensions, friction loss, manufacturing complexity, and overall cost”); Ex. 1003, ¶¶ 133-38,

160 (describing greater burst strength of round tubes); Ex. 2002, ¶¶108-110. Not one of these design parameters relates to shunt tube wall thickness.

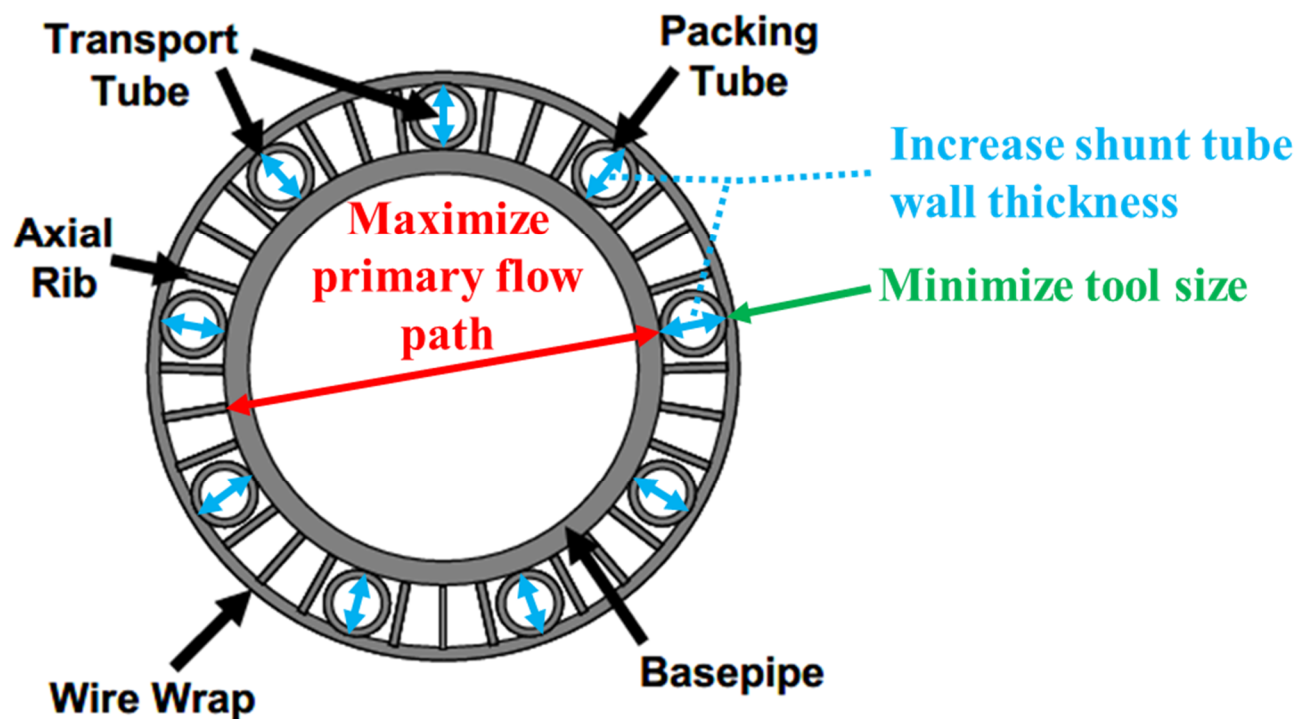
In light of *Yeh*'s clear teaching to use a concentric screen for a higher pressure rating, along with *Yeh2*'s accompanying concentric screen design that focuses on other design parameters and actually thins shunt tube walls, the Petition's conclusory statements that a POSITA "would have understood that a higher-pressure shunt tube assembly necessitated greater wall thickness" should not be credited as anything but hindsight. *See* Pet., p.42. Petitioner argues that a POSITA *could have* increased wall thickness, but that does not meet Petitioner's burden to show that a POSITA *would have* increased wall thickness, particularly when the art is replete with reasons a POSITA would have pursued a different solution. The Petition has not shown that the teachings of *Yeh* and *Yeh2* would have led a POSITA to an upstream screen with a greater wall thickness than the downstream screen. The *Yeh/Yeh2* combination in fact teaches just the opposite.

Moreover, the Petition offers no reason that a POSITA would have increased transport tube wall thickness of the upstream concentric screen to exceed that of tubes in the downstream eccentric screen. *Yeh* teaches concentric screens rated to 6,500 psi, more than twice the 3,000 psi rating of eccentric screens, extending gravel packing length by 50%. Ex. 1005, 28:17-20; Ex.1015, pp.1 (describing eccentric screen "maximum shunt system working pressure of 3,000 psi"), 3 (explaining that

increases in working pressure extended “the length limit by more than 50%). And concentric screens had been tested to 10,000 psi. Ex. 1015, p.3; Ex. 1003, ¶237; Ex. 2001, 48:2-8. Petitioner offers no reason for a POSITA to push pressure above 10,000 psi by increasing wall thickness, particularly when doing so would contradict the space constraints for secondary flow paths taught by *Yeh*. *See supra* §VI.B.1 (explaining *Yeh*’s teaching that the secondary flow path was constrained by the diameter of the primary flow path and the outer diameter of the tool).

Nor does the Petition address how a POSITA would have balanced shunt tube wall thickness with other design considerations in concentric screens. Both routes to increased shunt tube wall thickness in a concentric screen require changes that the art teaches against. First, increasing tube thickness without any change to outer diameter would restrict the flow path, increasing friction pressure drop and requiring a higher pressure rating for the same packable length. Ex. 2002, ¶113. Petitioner and Mr. Chambers recognize that increasing friction pressure drop increased pressure requirements. Pet., p.42 (“[L]esser wall thickness in transport tubes . . . result[ed] in lower friction pressure drop,” which “reduced the pressure requirement”); Ex. 1003, ¶296. And the alternative, increasing tube thickness by maintaining the secondary flow path and increasing outer diameter, requires a smaller diameter in the primary flow path—which *Yeh* teaches should be maximized—or a larger outer diameter of the tool—which *Yeh* explains (and Petitioner’s expert admits) is limited by adjacent

tools in the wellbore. *Supra* §VI.B.1 (explaining *Yeh*'s teachings regarding tool size and primary flow path); Ex. 1005, 28:5-8, 28:25-30; Ex. 1003, ¶295 (stating a POSITA would avoid “increasing outside diameter” because it “would require a greater tool size”); Ex. 2002, ¶113. Figure 10 of *Yeh2* illustrates how increasing shunt tube wall thickness (annotated in blue) restricts the primary flow path (annotated in red) and increases tool size (annotated in green):



Ex. 1006, Fig. 10 (annotated). Despite recognizing these other factors, Petitioner ignores their impact on sand screen design. Petitioner offers no reason a POSITA would have chosen to increase concentric screen pressure rating at the expense of these other design considerations that *Yeh* prioritizes.

And even if a POSITA had pursued higher pressure ratings in concentric screens by increasing wall thickness, Mr. Chambers calculates that round tubes at the sizes commonly used in concentric screens could support burst pressures of 14,700 psi without exceeding the 0.095-inch wall thickness of eccentric tubes. *See* Ex. 1003, ¶¶162 (noting wall thickness of 0.095 inches for rectangular tubes commonly used in eccentric screens), 184 (calculating burst pressure up to 14,745 psi for round tube with 0.095-inch wall thickness). Mr. Chambers does not explain why a person of skill would pursue a pressure rating exceeding 15,000 psi, when obtaining that rating requires ignoring clear teachings in *Yeh*.

Similarly, a POSITA would not have been motivated to decrease transport tube wall thickness in the downstream eccentric screen below the common thickness of 0.095 inches. As an initial matter, *Yeh* teaches that eccentric screens were limited to packing 3,000 feet. Ex. 1005, 30:15-20. A POSITA would have understood that this 3,000-foot limit was based on the eccentric screen's low pressure rating, such that further reducing pressure rating in eccentric screens by thinning shunt tube walls would reduce eccentric packing length. Ex. 1015, p.2 (teaching that a 3,200-foot length limit on packing with eccentric screens was based on limiting pressure to 3,000 psi); *see also* Ex. 2002, ¶103. And shorter packing length with the downstream eccentric screen would have required packing longer lengths with concentric screens, which *Yeh* teaches had greater friction loss, were more expensive, and were

less available. Ex. 1005, 30:20-33. A POSITA would not take a design path that introduced greater cost, with less performance, and complicated drilling operations. Ex. 2002, ¶103.

And Petitioner’s reasons for thinning shunt tube walls in downstream eccentric screens do not overcome *Yeh*’s clear teaching. The Petition and Mr. Chambers argue that a POSITA would have reduced wall thickness in the downstream eccentric screen for two reasons: (1) reduce costs, and (2) reduce friction pressure drop. Pet., pp.42-43; Ex. 1003, ¶¶295-96. Neither rationale holds up to scrutiny.

First, as to cost savings, *Yeh* teaches that a primary reason to use eccentric screens is to reduce use of expensive concentric screens. Ex. 1005, 30:20-29 (describing use of “less-expensive eccentric screens,” instead of “more complex concentric screens,” to “reduc[e] the overall cost of completion”). A POSITA would accordingly have been motivated to expand use of eccentric screens, to reduce the distance that required packing by more expensive concentric screens, rather than downgrading eccentric screens’ performance in a manner limiting their use. Ex. 2002, §XIII.A; *see also infra* §VI.E.

Second, as to reducing friction pressure drop, *Yeh* explains that its reason for using an eccentric screen downstream is to reduce friction losses and extend the packable length. Ex. 1005, 24:57-60. Petitioner purports that thinning the walls in eccentric screens would have reduced friction loss and extended packing length. Pet.,

p.42. But Petitioner’s expert claims that those of skill in the art had arrived at the maximum packing length for eccentric screens, near 3,200 feet, with a shunt tube wall thickness, 0.095 inches, that exceeded wall thickness for concentric screens. Ex. 1003, ¶¶132 (noting maximum 2x2 eccentric screen packing length of 3,200 feet); 162 (noting wall thickness of 0.095,” or 2.4 mm, in 2x2 eccentric-screen versus 2 mm in concentric-screen round tubes); Ex. 2002, ¶¶105-07. Petitioner’s conclusory assertion that thinning walls would extend packing length finds no support from Petitioner’s expert.

Petitioner also overlooks additional reasons that those of skill in the art would have known not to thin shunt tube walls for eccentric screens. Ex. 2002, ¶¶102-04. For example, Mr. Chambers states that a POSITA would reduce wall thickness in the eccentric screen instead of “increasing outside diameter” of the tube, due to constraints on tool size. Ex. 1003, ¶295. In doing so, he omits the fact that rectangular transport tubes used in eccentric screens already had a larger cross-sectional flow area than round transport tubes used in concentric screens—which was a significant reason for both their lower friction pressure drop and their lower pressure rating—and had done so without larger tool size. *See* Ex. 1003, ¶162 (noting rectangular eccentric tube dimensions of 0.75”x1.5” versus round concentric tubes of 20 mm outer diameter); Ex. 1005, 24:54-56 (explaining that “an eccentric screen arrangement offers lower friction . . . when compared to shunt tubes in a concentric

screen”); Ex. 1015, p.3 (explaining that eccentric screens were limited to 3,000 psi). The rectangular tube shape in eccentric screens offered one of skill in the art more space for shunt tubes without impacting tool size. Ex. 2002, ¶102.

Mr. Chambers further ignores that those of skill in the art had specifically chosen eccentric screens in order to achieve a larger shunt tube cross section without increasing tool size. Ex. 1003, ¶128 (explaining that eccentric designs “achieve the largest flow area for the transport tubes”); *see also* Ex. 1013, Fig. 5 (illustrating how an eccentric design reduces tool outer diameter while maintaining flow area in secondary flow paths). In short, persons of skill in the art had chosen eccentric screens for larger flow paths (both primary and secondary) relative to concentric screens, such that thinning eccentric screen walls would optimize performance metrics—friction loss and tool size—for which eccentric screens were already optimized. Ex. 2002, ¶103.

In summary, the Petition simply assumes that a POSITA would thicken shunt tube walls to increase pressure rating. But Petitioner’s own art teaches a POSITA to obtain higher pressure rating with concentric screens, which actually have thinner walls, and achieve higher pressure via other design parameters. And Petitioner’s conclusory rationale for modifying the *Yeh/Yeh2* combination to arrive at thicker shunt tube walls in an upstream concentric screen directly contradict *Yeh*’s teachings

to reduce friction pressure, reduce cost, and limit tool size. The Petition has not shown that Ground 1 renders obvious claim 1.

3. The Petition Raises an Inadequate Obvious-to-Try Argument

In short, nothing in the art teaches a POSITA to use an upstream concentric screen with greater wall thickness than the downstream eccentric screen. At best, the Petition argues that a POSITA could have found a greater wall thickness in an upstream concentric screen (or conversely, lesser wall thickness in a downstream eccentric screen) obvious to try. Pet., pp.42 (claiming a POSITA “would have understood that a higher-pressure shunt tube assembly necessitated greater wall thickness”), 43 (claiming a POSITA “would have expected success with reduced wall thickness in Yeh’s eccentric screens”). But the art teaches otherwise, and Petitioner’s arguments fall squarely within “obvious to try” scenarios that do not meet Petitioner’s burden to show obviousness.

An invention is not obvious when “what would have been ‘obvious to try’ would have been to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful.” *In re Kubin*, 561 F.3d 1351, 1359 (Fed. Cir. 2009). In this case, the art identifies numerous choices, then indicates that *other* parameters—particularly, the choice between concentric and eccentric screens—

were critical. The Petition claims that a POSITA would not only have varied numerous parameters to increase pressure ratings, minimize friction pressure loss, and extend packing length, but that a POSITA would have preferentially varied shunt tube wall thickness despite the art prioritizing other parameters, including screen configuration (concentric versus eccentric), number of tubes, tube geometry, and tube cross-sectional area. *See* Pet. ¶42 (stating a POSITA “would have understood that a higher-pressure shunt tube assembly necessitated greater wall thickness”); Ex. 2002, ¶108-111 (identifying other design parameters). The references Petitioner cites teaches a host of parameters a POSITA could have varied including:

- Screen configuration: concentric vs. eccentric (*e.g.*, Ex. 1015, pp.2-3);
- Manifolding (*e.g.*, Ex. 1006, Fig. 9);
- Shunt tube cross-sectional area (Ex. 1013, pp.3-4; Ex. 1003, ¶¶161-62);
- Shunt tube material (Ex. 1007, 4:11-13);
- Number of tubes, for transport and packing (*e.g.*, Ex. 1015, p.2-3);
- Shunt tube geometry, round versus rectangular (*e.g.*, Ex. 1006, p.4);
- Open-ended and closed-ended tubes (*e.g.*, Ex. 1006, Fig. 7);
- Tube nozzle size (*e.g.*, Ex. 1006, p.4);
- Tube nozzle spacing (*Id.*);
- Nozzle distance from manifold (Ex. 1006, p.5);

- Jumpers between tubes (Ex. 1016, p.3); and
- Fluid engineering, such as viscosity, gravel size, and gravel concentration (*e.g.*, Ex. 1006, p.2).

But Petitioner has not pointed to any teaching in the art to increase shunt-tube wall thickness in an upstream concentric screen, instead of modifying these other design parameters. Ex. 2002, ¶¶88-92 (explaining that *Yeh* describes crossover-joint wall thickness, not shunt-tube wall thickness), ¶109 (noting *Yeh2* does not teach anything about shunt-tube wall thickness), ¶¶108-111 (summarizing alternate design parameters taught in the art and design factors a POSITA would have considered). And a POSITA designing screens had to balance numerous performance metrics against one another, including:

- Extending packing length (*e.g.*, Ex. 1005, 30:15-20);
- Increasing pressure rating (*Id.*);
- Reducing friction pressure loss (*e.g.*, Ex. 1005, 24:54-57);
- Reducing leak-off (*e.g.*, Ex. 1006, p.5);
- Maximizing the primary flow path (Ex. 1005, 28:5-8, 28:25-30);
- Maintaining or reducing tool size (*Id.*, 26:61-64, 28:25-30);
- Avoiding plugging, sand-bridging, and voids (*e.g.*, Ex. 1006, p.2);
- Reducing cost and improving availability, not only for a single screen but for the entire well (Ex. 1005, 30:20-32).

Claim 1 is not rendered obvious by the Petition’s say-so that a POSITA would have prioritized wall thickness and pressure rating over numerous other design parameters and performance metrics, each of which is identified in the art as a significant consideration.

Similarly, an invention is not obvious when “the prior art gave only general guidance as to the particular form of the claimed invention or how to achieve it.” *In re Kubin*, 561 F.3d 1351, 1359 (Fed. Cir. 2009). Petitioner’s art, in *Yeh* and *Yeh2*, only gives general guidance to increase shunt tube pressure ratings and reduce friction loss to extend packing length. Ex. 1005, 24:54-60 (“[A]n eccentric screen arrangement offers lower friction”), 30:15-17 (recommending concentric screens for “gravel packing long intervals”); Ex. 1006, p.5 (“Burst strength of shunt tubes” must handle “high hydraulic pressure” of 5,300 psi). And instead of giving general guidance, Petitioner’s art actively guides a POSITA toward a solution—using concentric screens upstream—that leads away from the invention of claim 1. Ex 2002, §XI.A.2.

The Petition’s claims that increasing upstream shunt tube wall thickness would have been obvious to try, when compared to controlling legal standards, are not sufficient to render claim 1 obvious.

4. *Yeh* Offers a Different Solution

In other words, while the combination of *Yeh* and *Yeh2* may identify the same problem as the '007 Patent, the combination teaches a different solution than the '007 Patent. This is not enough to meet Petitioner's burden to demonstrate obviousness. *Cardiac Pacemakers, Inc. v. St. Jude Med., Inc.*, 381 F.3d 1371, 1377 (Fed. Cir. 2004) ("Recognition of the problem . . . does not render obvious the eventual solution. Recognition of a need does not render obvious the achievement that meets that need.").

Yeh identified the need to gravel pack longer lengths, and accordingly identified a need for shunt tube systems rated to higher pressures capable of packing longer lengths. Ex. 1005, 30:15-20. But *Yeh* solved that problem with a concentric screen rated to higher pressure, rather than by reducing friction pressure loss (as in eccentric screens) or modifying shunt tube wall thickness. A POSITA presented with the teachings of *Yeh* would have pursued a solution—placing concentric screens upstream—that led diametrically away from increasing shunt tube wall thickness. Ex. 2002, §XI.A.2 (explaining *Yeh/Yeh2*'s proposed solution), ¶¶105-07 (explaining that the *Yeh/Yeh2* solution results in thinner walls in an upstream concentric screen). And as explained in *Yeh2*, concentric screens achieved a higher pressure rating and longer packing intervals with solutions—a higher number of small, round tubes,

closed-ended packing tubes, and manifolds—that led to thinner shunt tube walls. Ex. 1006, Figs. 9-10; Ex. 2002, ¶¶108-111.

Accordingly, *Yeh* and *Yeh2* recognized a problem—the need for higher sand screen pressure ratings—that the '007 Patent also solves. But that is not enough to render claim 1 obvious, particularly in light of *Yeh* and *Yeh2* teaching toward a different solution incompatible with the solution of claim 1.

5. Petitioner Relies on Hindsight that Contradicts the Clear Teachings of *Yeh* and *Yeh2*

Petitioner uses hindsight to assume that a POSITA would increase wall thickness in an upstream shunt tube. But that is not what Petitioner's references teach. *Yeh* teaches a POSITA to use a concentric sand screen upstream: a different solution than increasing wall thickness. Ex. 1005, 30:13-20. *Yeh2* similarly teaches using concentric screens for higher pressures and remains silent on shunt tube wall thickness. Ex. 1006, p.5. The Petition's mere assumption that a POSITA knew to thicken shunt tube walls to increase pressure rating does not render claim 1 obvious over the clear teachings of *Yeh* and *Yeh2*. *See In re Kotzab*, 217 F.3d 1365, 1371 (Fed. Cir. 2000) (reversing obviousness finding for lack of substantial evidence, even though obviousness theory relied on “a technologically simple concept”).

Neither the Petition nor Mr. Chambers offers reasons a POSITA would ignore *Yeh*'s clear teaching to use concentric screens at higher pressures for packing longer intervals. Petitioner's expert admits that using concentric screens for increased

pressure requirements was the conventional wisdom. Ex. 1003, ¶236. And the invention of claim 1 bucks that conventional wisdom by instead using a greater shunt tube wall thickness in the upstream screen. The Federal Circuit has repeatedly recognized that proceeding “contrary to the accepted wisdom” in the art represents “strong evidence of unobviousness.” *In re Hedges*, 783 F.2d 1038, 1041 (Fed. Cir. 1986).

Accordingly, Petitioner’s Ground 1 fails as to claims 1-10 because the *Yeh/Yeh2* combination does not disclose or render obvious each element of independent claim 1.

C. Ground 1 Also Fails as to Dependent Claims 2, 4, and 5

1. Ground 1 Does Not Render Obvious Claim 2

Claim 2 requires “a cross-sectional flow area of the packing tube nozzle opening in the first sand screen assembly is less than a cross-sectional flow area of the packing tube nozzle opening in the second sand screen assembly.” But the *Yeh/Yeh2* combination does not disclose or render obvious increasing the packing tube nozzle opening in the downstream eccentric screen to be larger than the packing tube nozzle opening in the upstream concentric screen.

Petitioner points to *Yeh2* Figure 7 to show declining flow rates. Pet., p.46. But *Yeh2* Figure 7 teaches a POSITA to address declining flow along a packing tube by using a closed-end tube, not by increasing nozzle size. Ex. 1006, p.4, Figs. 7-8; Ex.

2002, §XI.B; Ex. 2001, 39:1-10 (explaining that closed-ended tubes result in “more pressure”). Moreover, neither *Yeh* nor *Yeh2* teach that declining flow rate near the toe is a significant problem that a POSITA should address. *See generally* Exs. 1005, 1006; Ex. 2002, §XI.B. So the art does not identify downstream flow rate as a problem, and the art that Petitioner relies on as showing declining flow rate actually solves the alleged problem with a different solution than nozzle size.

In addition, a POSITA would not have increased nozzle sizes in a downstream eccentric screen because *Yeh* and *Yeh2* teach against it. *Yeh* teaches use of eccentric screens downstream because eccentric screens “offer lower friction” and extend packing length. Ex. 1005, 24:54-60. And as Petitioner recognizes, greater nozzle diameter would *increase* friction pressure drop, reducing the benefit of extending packing length due to using a low-friction eccentric screen at the toe. *See* Pet., p.45 (noting that pressure drop is directly proportional to hole size); Ex. 1003, ¶¶303-04; Ex. 2001, 68:9-13 (agreeing that “as flow rate increases, the friction pressure loss increases”). And *Yeh2* teaches a POSITA not to exceed (and indeed uses) a maximum nozzle size, which is based on the gravel size, in order to avoid “excessive fluid leakoff.” Ex. 2002, ¶119 (explaining that the 6 mm nozzle size used in *Yeh2*’s design corresponds to the maximum recommended size: 10 times the gravel size of 0.6 mm); Ex. 1006, p.2 (stating that larger portholes facilitate flow but also “allow excessive fluid leakoff”). Accordingly, Ground 1 also fails to render claim 2 obvious

because Petitioner offers no reason a POSITA would prioritize increasing flow rate against both *Yeh*'s teaching to minimize friction and extend length and *Yeh2*'s teaching to limit maximum nozzle size based on gravel size and leakoff rates.

2. Ground 1 Does Not Render Obvious Claim 4

Claim 4 requires “the number of packing tube nozzles in the first sand screen assembly is less than the number of packing tube nozzles in the second sand screen assembly.” But for the same reasons as discussed in regard to claim 2, the *Yeh/Yeh2* combination does not disclose or render obvious increasing the number of packing tube nozzles in the downstream sand screen. *See supra* §VI.C.1; Ex. 2002, §XI.D. Petitioner's arguments for claim 4, like claim 2, fail to address why a POSITA would have prioritized increasing flow rate near the toe over reducing friction, extending packing length, and avoiding fluid leakoff. *See Pet.*, pp.51-52. Increasing the number of nozzles would increase friction loss, reduce packing length, and increase leakoff in a similar manner to increasing nozzle diameter. Ex. 2002, ¶123.

And as with increasing nozzle diameter, *Yeh2* teaches against decreasing the spacing between packing tube nozzles (i.e., increasing the number of packing tube nozzles). *Yeh2* teaches an “acceptable range” of nozzle spacing, not less than six feet. Ex. 2002, ¶129; Ex. 1006, p.2. Neither Petitioner nor Mr. Chambers explain why a POSITA would separate nozzles by less than the six-foot nozzle spacing of

Yeh2 to improve flow rate—a performance metric that neither *Yeh* nor *Yeh2* teaches needs improvement—when both *Yeh* and *Yeh2* teach against it.

3. Ground 1 Does Not Render Obvious Claim 5

Claim 5 requires “the cross-sectional flow areas of the passageway in the first and second transport tubes is the same.” But the *Yeh/Yeh2* combination does not disclose or render obvious the same cross-sectional flow area in the upstream and downstream sandscreens, and in fact teaches the opposite. Ex. 2002, §XI.E.

As discussed above for claim 1, the Petition relies on an embodiment of *Yeh* teaching an upstream concentric screen and a downstream eccentric screen as teaching claim 1, and thus also for claim 5 that depends from claim 1. *See* Pet., p.33-34. Concentric screens commonly used round shunt tubes in a 6x3 configuration (6 transport tubes, 3 packing tubes). Ex. 1006, Fig. 10. And as Petitioner’s expert Mr. Chambers acknowledges, eccentric screens, in contrast, commonly used rectangular tubes in a 2x2 configuration (2 transport tubes, 2 packing tubes). Ex. 1003, ¶¶111, 162 (noting that such “conventional” eccentric screens have become “commonplace in the industry”); Ex. 2002, ¶¶94, 128. Mr. Chambers, however, compared the cross-section of round tubes to round tubes and the cross-section of rectangular tubes to rectangular tubes. Ex. 2001, 55:9-56:20 (confirming that in Mr. Chambers calculations, the upstream and downstream tube are both round or both rectangular). In doing so, Mr. Chambers compared cross-sectional flow areas of concentric

screens with concentric screens, and eccentric screens with eccentric screens, but Petitioner's arguments for claim 5 require the same cross-sectional flow area in round concentric tubes and rectangular eccentric tubes. Ex. 2002, §XI.E.

Mr. Chambers also explains in his declaration that rectangular tubes were chosen in eccentric screens for greater flow area and reduced friction pressures, and round tubes were chosen in concentric screens for greater pressure rating. Ex. 1003, ¶¶160, 162; *see also* Ex. 2002, ¶¶94 (explaining use of rectangular tubes in eccentric screens for greater flow area), 100-02 (explaining use of round tubes in concentric screens for greater pressure rating). And Mr. Chambers' calculations prove that round tubes in concentric screens and rectangular tubes in eccentric screens have different cross-sectional flow areas. Ex. 1003, ¶162. For example, Mr. Chambers explains the use of 0.75"x1.5" (0.56"x1.31" internal) rectangular tubes in eccentric screens and round tubes having 16 mm inner diameter in concentric screens, yielding a different cross sectional flow area for concentric round tubes than eccentric rectangular tubes. *Id.*; *see also* Ex. 2002, ¶¶141-45 (calculating different cross sectional areas in Mr. Chambers' examples of concentric shunt tubes versus eccentric shunt tubes and explaining reasons for different cross sectional areas, including friction pressure loss and space constraints).

Accordingly, Petitioner's reliance on an upstream concentric screen and a downstream eccentric screen does not teach that "the cross-sectional flow areas of

the passageway in the first and second transport tubes is the same.” Instead, Petitioner’s expert Mr. Chambers performs calculations that demonstrate different cross-sectional flow areas of the passageways in the two tubes.

D. Ground 2 Fails as to Claims 14-20 because the *Yeh/Yeh2/Jones2* Combination Does Not Disclose or Render Obvious Each Element of Independent Claim 14

The Petition has not shown that the prior art discloses or suggests “determining a shunt tube system operating pressure associated with the distal end of the production zone and selecting a low pressure shunt tube system based on the distal end determined pressure,” as required by claim element 14[c].

The Petition relies on the distal end determined pressure to be that of the toe. Pet., pp.63-64 (describing a “downstream distal end at the toe” of *Yeh*’s wellbore). Petitioner then alleges that claim element 14[c] is taught by *Yeh*’s use of an eccentric screen downstream and Figure 15 of *Yeh2*, which illustrates pressure drop over the length of the wellbore. Pet., pp.65-66.

But instead of relying on a selection of a low pressure shunt tube system based on that distal end determined pressure, the Petition admits that the proposed combination selects the downstream screen based on pressure “3,000 feet from the toe.” *Id.*, p.66. Ex. 2002, §XII.A.

Petitioner’s expert confirms this deficiency in the Petition. In his declaration, Mr. Chambers claims that the art teaches eccentric screen working pressure of 3,000

psi, which a POSITA would have understood to permit use “3,000 feet from the toe.” Ex. 1003, ¶388. Mr. Chambers confirmed in his deposition that a POSITA “would select [an] eccentric screen based on the pressure that exists 2,000 feet from the heel,” or “3,000 feet from the toe.” Ex. 2001, 61:21-62:3. Accordingly, Petitioner has not shown that a POSITA would have selected a downstream screen “based on the distal end determined pressure”—which is at the toe in the Petition (*see* pp.63-64)—because Petitioner instead argues a POSITA would have selected a downstream screen based on the pressure 3,000 feet from the toe.” Ex. 2002, §XII.A.

The Petition thus fails to render obvious claims 14-20.

E. Grounds 3-4 Fail as to Claims 21-23 because the *Yeh/Yeh2/Jones* Combination Does Not Disclose or Render Obvious Each Element of Independent Claim 21

The *Yeh/Jones* combination of Ground 3 and the *Yeh/Jones/Yeh2* combination of Ground 4 fails to render obvious claim 21. The combinations do not disclose or render obvious claim element 21[e]: “wherein the transport tube of the first sand screen assembly is formed of a first material and the transport tube of the second sand screen assembly is formed of a second material, the first material having a greater tensile strength than the second material.”

Petitioner argues in Grounds 3-4 that a POSITA would have used a concentric screen upstream and an eccentric screen downstream. Petition, pp.32-34 (describing *Yeh*’s “concentric screen” as “the first sand screen assembly” and *Yeh*’s “eccentric

screen” as “the second sand screen assembly” in claim 1), 76-78 (relying on *Yeh*’s upstream concentric screen and downstream eccentric screen, as argued for claim 1, for elements of claim 21). According to the Petition, this combination teaches an upstream concentric screen (mapped to the claimed “first sand screen assembly”) with a higher pressure rating than the downstream eccentric screen (mapped to the claimed “second sand screen assembly”). Pet., p.78; *see also id.*, pp.41, 60.

The Petition then states, in conclusory fashion, that “a POSITA needing to decrease burst pressure” would have “decreased tensile strength.” Pet. p.78. But to render claim 21 obvious, it is not sufficient to show merely that a POSITA could have used stronger or weaker materials as a general matter; the Petition must show that a POSITA would have used a transport tube material in the upstream concentric screen that is stronger than the transport tube material in the downstream eccentric screen. *See* Ex. 1001, Claim 21 (requiring “the first material having a **greater** tensile strength **than the second material**”) (emphasis added).

The Petition further assumes that a POSITA would achieve a lower pressure rating by using a weaker material in the downstream screen. Pet. p.78 (“[I]t would have been obvious to use different steels . . . to achieve a different pressure rating between the concentric and eccentric screens”). But as addressed for Ground 1, those in the art had chosen a different solution—using concentric screens with a higher

number of smaller, round shunt tubes—to address pressure rating issues. *See supra* §VI.B.2-4.

Based on the teachings of *Yeh*, a POSITA would not have used a weaker transport tube material in the downstream eccentric tube than in the upstream concentric tube. Ex. 2002, §XIII.A. *Yeh* teaches that “an eccentric screen arrangement offers lower friction . . . when compared to shunt tubes in a concentric screen.” Ex. 1005, 24:55-57. Accordingly, *Yeh* instructs a POSITA to use eccentric screens downstream to “reduce the overall friction or extend the maximum gravel packing length” of the well. *Id.*, 24:58-60. Applying Petitioner’s own logic, a POSITA would not have used a weaker material in the downstream eccentric screen (relative to the upstream concentric screen) because doing so would reduce the eccentric screen’s pressure rating and thus its packable length. Ex. 2002, ¶¶171-73. *Yeh* actively teaches against further reducing the pressure rating and packing length of the downstream eccentric screen, and instead teaches to use eccentric screens to extend packing length. Ex. 2002, §XIII.A.

In contrast, a POSITA would have understood that using a weaker material in the downstream eccentric screen would result in packing a longer length with the concentric screen. *Yeh* taught that eccentric screens were limited to packing 3,000 feet (Ex. 1005, 30:17-20), so lengths beyond 3,000 feet must be packed with a concentric screen, and more so if the eccentric screen used weaker material. Ex.

2002, ¶172. But using a concentric screen over a longer length directly contradicts two clear teachings in *Yeh*. First, *Yeh* teaches a POSITA to “reduce the overall cost of the completion” by using “less-expensive” and “more readily available eccentric screens” where possible, in place of the “more complex concentric sand screens.” Ex. 1005, 30:20-29. A POSITA faced with packing a greater length would choose to pack as much of that length as possible with cheaper, readily available screens. Ex. 2002, ¶¶170-73. Second, as noted above, the lower friction loss of eccentric screens meant that a POSITA would prioritize using eccentric screens over concentric screens to extend the total gravel pack length. *See* Ex. 2002, ¶¶170-73.

The Petition assumes that availability of stronger materials would lead a POSITA to downgrade the eccentric screen to save cost. Pet., p.78. *Yeh* instead teaches a POSITA to prioritize use of eccentric screens over concentric screens to save cost. Ex. 1005, 24:54-60, 30:20-29. Grounds 3-4 do not render claims 21-23 obvious because Petitioner fails to address why a POSITA would ignore *Yeh*’s teaching to maximize use of downstream eccentric screens, which were chosen over concentric screens to improve cost, availability, and friction loss.

F. Ground 4 Also Fails as to Dependent Claim 22 due to its Incorporation of Ground 1

Claim 22, like claim 1, includes the limitation “wherein the transport tube of the first sand screen assembly has a first wall thickness and the transport tube of the second sand screen assembly has a second wall thickness, the first wall thickness

being greater than the second wall thickness.” Ground 4 of the Petition relies on Petitioner’s arguments from Ground 1 for claim 22. Pet., p.78-79 (relying on Petitioner’s arguments for claim 1[e] for “adjusting the shunt tube wall thickness”). Accordingly, in addition to the reasons discussed in the previous section, Petitioner’s Ground 4 does not render claim 22 obvious for the same reasons Petitioner’s Ground 1 does not render claim 1 obvious. *See supra* §§VI.B,E.

* * * * *

Accordingly, Petitioner has failed to demonstrate that challenged claims 1-10 and 14-23 are rendered obvious by Grounds 1, 2, 3, and 4 in the Petition.

VII. CONCLUSION

For the foregoing reasons, Patent Owner respectfully requests that the Board deny the Petition.



March 7, 2025

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing Response has a word count of 9,337, as defined by 37 C.F.R. § 42.24 using the word count feature of Microsoft Word.

March 7, 2025

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CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. § 42.6(e), the undersigned certifies that on the 7th day of March, 2025, a complete and entire copy of PATENT OWNER'S RESPONSE UNDER 37 C.F.R. § 42.120 and related documents were served on Petitioner via electronic mail to counsel for Petition at the following addresses:

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