

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.

IPR2024-00990
Patent 11,333,007 B2

Before HUBERT C. LORIN, JAMES L. MAYBERRY, and
BRENT M. DOUGAL, *Administrative Patent Judges*.

LORIN, *Administrative Patent Judge*.

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

I. INTRODUCTION

A. Background

Weatherford U.S., L.P. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–12 and 14–23 of U.S. Patent No. 11,333,007 B2 (Ex. 1001, “the ’007 patent”). Halliburton Energy Services, Inc. (“Patent Owner”) did not file a Preliminary Response.

We have jurisdiction under 35 U.S.C. § 6.

Upon consideration of the arguments and evidence presented by Petitioner, 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 challenged claim. Accordingly, we grant Petitioner’s request and institute an *inter partes* review of claims 1–12 and 14–23 of the ’007 patent.

B. Related Proceedings

Petitioner indicates, and Patent Owner agrees, that the ’007 patent is being asserted in *Halliburton Energy Services, Inc. et al. v. Weatherford U.S.*, No. 6:24-cv00090 (W.D. La. 2024). Pet. 83; Paper 3, 2.

C. The ’007 patent (Ex. 1001)

1. Disclosure

The ’007 patent, titled “Multiple Shunt Pressure Assembly For Gravel Packing,” relates to “screen assemblies of lower production systems used in wellbore gravel packing, and more particularly to shunt tube systems utilized in the sand screen assemblies.” Ex. 1001, code (54), 1:17–20.

The '007 patent explains that “[d]uring production of the formation fluid, formation sand may be swept into the flow path of the production fluid as it passes along [a production] tubing string. The formation sand tends to be relatively fine sand that can erode production components in the flow path.” Ex. 1001, 1:25–30. When this is expected to occur, one or more lower production assemblies, including a perforated base pipe surrounded by a sand screen to filter fines (i.e. finely crushed or powdered material) from the formation fluid, may be installed. *Id.* at 1:31–36. “The annulus around the sand screen can then be ‘gravel packed’ with a relatively coarse sand (or gravel) which acts as a filter to reduce the amount of fine formation sand reaching the screen.” *Id.* at 1:39–42.

During the gravel packing process, a premature loss of the carrier fluid into the formation, known as leak-off, can occur, resulting in the formation of sand bridges in the annulus about the screening. With a premature loss of carrier fluid, incomplete packing around the sand screen and reduce the filtering efficiency of the gravel pack.

Id. at 47–53. One conventional approach to solving this problem is to longitudinally extend shunt tubes through the sand screen section. *Id.* at 1:54–57. The '007 patent claims to provide an improved approach.

To that end, the '007 patent describes, via Figure 1 reproduced below, a completion assembly (82) in a horizontal portion of a wellbore (12) extending “through various earth strata in an oil and gas formation 14 [from which hydrocarbons are produced] located below the earth’s surface 16.” Ex. 1001, 4:43–44, quoting 3:42–43. Figure 1 shows the lower completion assembly (82) comprising a packer (86), first upper and second lower sand screen assemblies (88, 96), and a shunt tube system (97) in each sand screen

assembly that includes a transport tube and a packing tube, where each packing tube includes a plurality of nozzles. *Id.* at 3:13–16, 4:44–47.

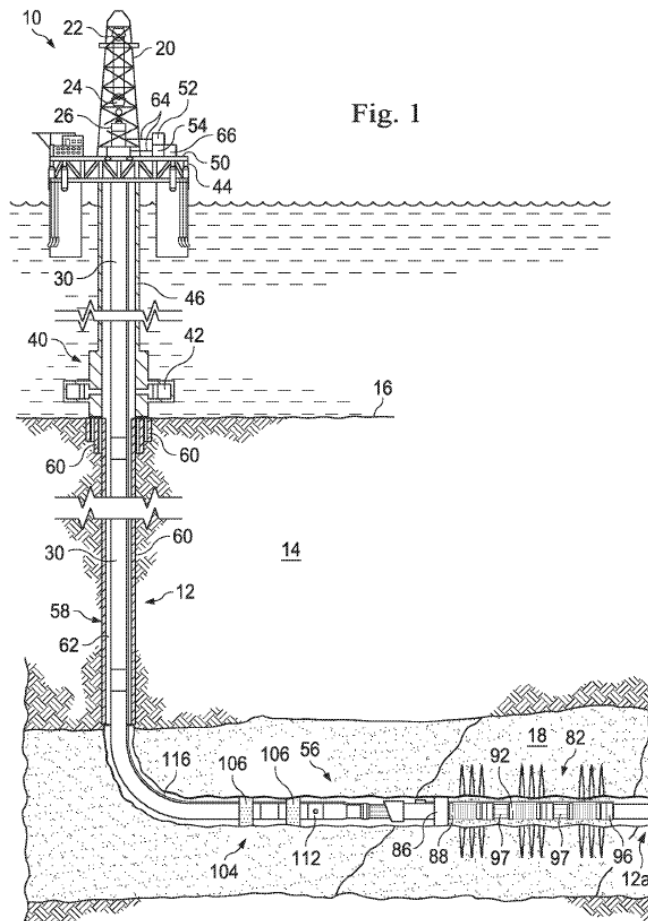


Figure 1 is “a cut-away view of a wellbore system having a lower completion system [82] disposed therein.” Ex. 1001, 2:21–22.

As shown in Figure 2 of the '007 patent, reproduced below, the lower completion assembly (82) comprises interconnected first (202) and second sand screen assemblies (204). Ex. 1001, 5: 6–9. Each sand screen assembly includes a perforated (208) base pipe (206) and a shunt tube assembly (220) disposed outwardly of filter media (220). *Id.* at 5:14–16. “[T]he base pipe 206 may be slotted and/or include perforations of any shape so long as the perforations permit fluid communication of production fluid between an

interior throughbore 228 and an exterior 230 of the screen assembly.” *Id.* at 5:37–40. The shunt tubes (224) are “in the form of a transport tube or a packing tube disposed along and generally parallel to the base pipe 206.” *Id.* at 5:24–26.

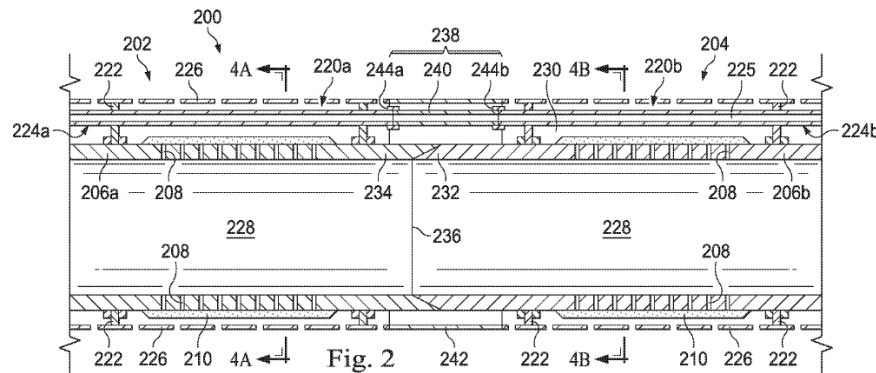


Figure 2 is “a partial cross-sectional view of a lower completion assembly (200).” Ex. 1001, 2:23–24.

Figure 4A, reproduced below, shows a cross-section of the first sand screen assembly (202) and the shunt tubes (224) arranged to one side of the base pipe (206a) and “having an eccentric alignment.” Ex. 1001, 7:30–31, 46–47. The shunt tubes (224) “generally comprise tubular members disposed outside of and generally parallel to the base pipe [206a].” *Id.* at 34–36. The two shunt tube assemblies (220a and 220b) each comprise a transport tube 410 and a packing tube 412. *Id.* at 7:49–51. Each transport and packing tube has a cross-sectional flow area A1 and B1, respectively. *Id.* at 7:53–54. Each packing tube further includes one or more nozzles 418 through which fluids may flow to facilitate gravel packing. *Id.* 7:55–57.

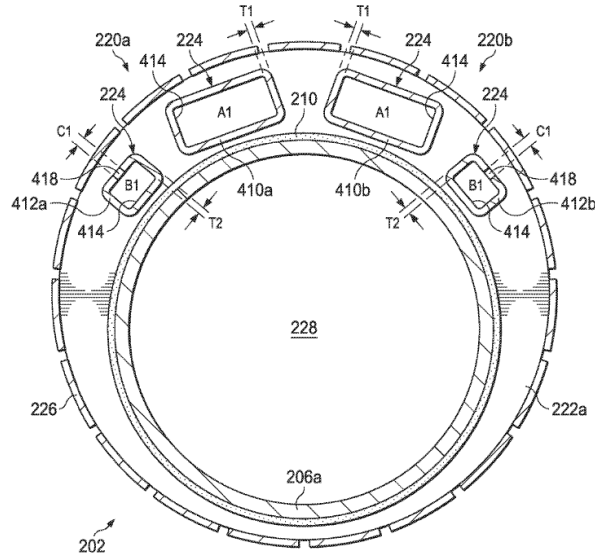


Fig. 4A

Figure 4A is “is a cross-sectional view of an embodiment of a shunt tube assembly along line A-A' of [Figure] 2.” Ex. 1001, 2:28–29.

The '007 patent explains that “[t]raditionally, when a lower production assembly is installed along the length of a production zone, the lower production assembly is generally comprised of multiple sand screen assemblies with shunt tube assemblies all of the same pressure rating.” Ex. 1001, 9:3-7. “[A]s gravel pack intervals increase, it has been necessary to employ shunt tube assemblies with increased operating pressure ratings or burst pressures, resulting in heavier and/or bulkier tubing and components to ensure that the shunt tube assemblies will not be subject to burst pressure.” *Id.* at 9:15–20.

[A]s the slurry flows from the upstream portion of these elongated production zone to the downstream portion of the production zone, the pressure of the slurry drops off. As such, only the shunt tube assemblies deployed adjacent the upper portion of the production zone experience the highest pressures.

In addition, because of the high pressure experienced by shunt tube assemblies at the upper or upstream end of such lower production assemblies deployed in elongated production zones, there is a tendency for greater leak-off in the upstream portion of the production zone.

Id. at 9:25–35.

The '007 patent details various solutions to overcome these drawbacks, such as selecting:

1. a shunt tube system flow regime in the second sand screen assembly that allows for a larger volume of fluid to flow therethrough than that of the first sand screen assembly by adjusting cross-sectional flow areas, location and number of nozzles (Ex. 1001, 9:36–41);
2. a geometry of the shunt tube assemblies of the first sand screen assembly to have a higher operating pressure than the shunt tube assemblies of the second sand screen assembly (*id.* at 9:42–45);
3. a thickness for the wall of transport or packing tubes of the first sand screen assembly to be greater than the thickness of the wall of transport or packing tubes tube of the second sand screen assembly (*id.* at 9:46–53);
4. a stronger construction material for the transport/packing tubes of the first sand screen assembly (*id.* 9:58–65); or,
5. a higher operating pressure for the shunt tube assemblies utilized in the first sand screen assembly than the shunt tube assemblies of the second sand screen assembly (*id.* at 9:66–10:4).

2. *Claims 1–12 and 14–23*

Petitioner challenges claims 1–12 and 14–23. Pet. 29.

Claims 1, 11, 14, and 21 are the independent claims from which claims 2–10, 12, 15–20, and 22–23 depend, respectively. Claim 1 is reproduced below in the Analysis section.

D. Asserted References

Petitioner relies on the following references¹:

Name	Reference	Ex. No.
Yeh	U.S. Patent No. 9,797,226 B2, issued Oct. 24, 2017	1005
Yeh2	C. S. Yeh, at al., “Unlocking the Limits of Extreme Length in Alternate Path Gravel Packing,” IPTC 12549, International Petroleum Technology Conference, 2008	1006
Jones	U.S. Patent No. 4,945,991, issued Aug. 7, 1990	1007
Jones2	U.S. Patent No. 5,113,935, issued May 19, 1992	1008

Petitioner also relies on the Declaration of Michael R. Chambers, Sr., (Ex. 1003, “Chambers Decl.”) as support for the various contentions.

E. Asserted Grounds

Petitioner contends that claims 1–12 and 14–23 of the ’007 patent are unpatentable under the following grounds:

Ground	Claims Challenged	35 U.S.C. §	Reference(s)/Basis
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¹ We limit the list to the references cited in the asserted grounds. *See* section I.E. Petitioner discusses other publications (not listed here) in, for example, the background section of the Petition. *See* Pet. 3–28 (“II. BACKGROUND”).

I	1–12	§ 103 ²	Yeh optionally in view of Yeh2
II	14–20	§ 103	Yeh in view of Yeh2 and optionally Jones2
III	21–22	§ 103	Yeh in view of Jones
IV	23	§ 103	Yeh in view of Jones and Yeh2

Pet. 30.

II. ANALYSIS

A. Principles of Law for Patentability

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which said subject matter pertains. 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 ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

² The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. §§ 102 and 103, effective March 16, 2013. Because the challenged claims of the ’007 patent have an effective filing date after the effective date of the applicable AIA amendments, we refer to the AIA versions of 35 U.S.C. § 103 throughout this Decision.

“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), 815 F.3d at 1363 (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

B. Level of Ordinary Skill in the Art

Petitioner contends:

[at] the time of the alleged invention in 2018, a POSITA^[3] would have had a B.S. degree in mechanical or petroleum engineering or a similar technical discipline, with at least five years of experience in oil or gas well drilling, completion, and/or subsurface production operations or in technical support of such operations including at least some experience in unconsolidated formations utilizing sand control methods and means. Also, additional education in a relevant technical discipline could compensate for less experience in the relevant field, and vice versa.

Pet. 31–32 (citing Ex. 1003 ¶¶ 36–40).

Petitioner’s proposed definition of a person of ordinary skill in the art appears reasonable, and we adopt that definition for our analysis in this decision.

³ Person of ordinary skill in the art.

That being said, we see no reason why the level of ordinary skill in the art is not adequately reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995); *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978).

*C. Claim Construction*⁴

Only those terms that are in controversy need to be construed, and 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). That being said, Petitioner does not offer any constructions for any terms of the challenged claims. *See* Pet. 29 (“Petitioner believes no limitations require explicit construction for the claims to be found unpatentable.”) (citing Ex. 1003 ¶¶ 41–42).

F. Overview of the Prior Art References

1. Yeh (Ex. 1005)

Yeh is titled “Crossover Joint for Connecting Eccentric Flow Paths To Concentric Flow Paths,” and relates to the use of screens and gravel packs in wellbores. Ex. 1005, code (54), 1:28–30.

Yeh explains that “[i]n some instances, a wellbore is completed in a formation that is loose or ‘unconsolidated.’ This means that as production fluids are produced into the wellbore, formation particles, e.g., sand and

⁴ 37 C.F.R. § 42.100 (2023); *see also Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005).

finer, may also invade the wellbore. Such particles are detrimental to production equipment.” Ex. 1005, 1:60–64.

There are closed and open-hole completions. “In an open-hole completion, a production casing is not extended through the producing zones and perforated; rather, the producing zones are left uncased, or ‘open.’” Ex. 1005, 2:8–10. “[T]he problem of unconsolidated formations is much more pronounced when a wellbore is formed as an ‘open hole’ completion.” *Id.* at 2:5–7.

A “common problem in open-hole completions is the immediate exposure of the wellbore to the surrounding formation. If the formation is unconsolidated or heavily sandy, the flow of production fluids into the wellbore may carry with it formation particles, e.g., sand and fines . . . [which] can be erosive to production equipment downhole and to pipes, valves and separation equipment at the surface.” Ex. 1005, 2:26–32. “To control the invasion of sand and other particles, sand control devices may be employed.” *Id.* at 33–34. “A sand control device typically includes an elongated tubular body, known as a base pipe, having numerous slotted openings. The base pipe is then typically wrapped with a filtration medium such as a screen or wire mesh. To augment sand control devices, particularly in open hole completions, it is common to install a gravel pack.” *Id.* at 37–43.

However, with gravel-packing there may be “an inadvertent loss of carrier fluid from the slurry during the delivery process can result in premature sand or gravel bridges being formed at various locations along open-hole intervals.” Ex. 1005 2:61–66. Shunt tubes “that allow the gravel slurry to bypass selected areas along a wellbore” have been used to solve

this problem. *Id.* at 3:10–12. In one alternative, “rectangular shunt tubes that are eccentrically attached to the outside of a sand screen” may be used. *Id.* at 3:23–24. “The eccentric layout reduces the overall diametrical size of the tool compared to if the equivalent shunt tubes were attached concentrically.” *Id.* at 3:31–33. Although, “sand screen[s] having concentric internal shunt tubes” have also been included. *Id.* at 3:36–37. According to Yeh, it is “it desirable to connect to joints of sand screen, wherein one joint has a concentric primary flow path, and another has an eccentric primary flow path.” *Id.* at 3:60–62. Yeh provides an example using a crossover joint represented as follows:

concentric screen → crossover tool → eccentric screen

Id. at 30:16.

2. *Yeh2 (Ex. 1006)*

Yeh2 describes improvement in “Alternate Path[®] technology (APT)” which “is a field-proven gravel packing technique for multi-zone, long interval, or horizontal wells.” Ex. 1006, page 1. Yeh2 explains that

In challenging well environments (e.g., deepwater, extended reach drilling), conventional gravel packing methods are often terminated prematurely due to sand bridging in the wellbore, resulting in incomplete gravel packing and decreased protection from sand ingress. APT provides alternate flow paths around a sand bridge by diverting the slurry (gravel + carrier fluid) through shunt tubes. The slurry is delivered to the annular voids through distributed nozzles in the shunt tubes until a complete pack is placed in the wellbore.

Id. “Shunt tubes remain inactive until the annulus is blocked during the gravel pack operation. APT diverts flow through the shunt tubes and by-

passes any blockage, such as a premature sand bridge, to continue gravel packing” as shown in Figure 1, reproduced below. *Id.* at page 2.

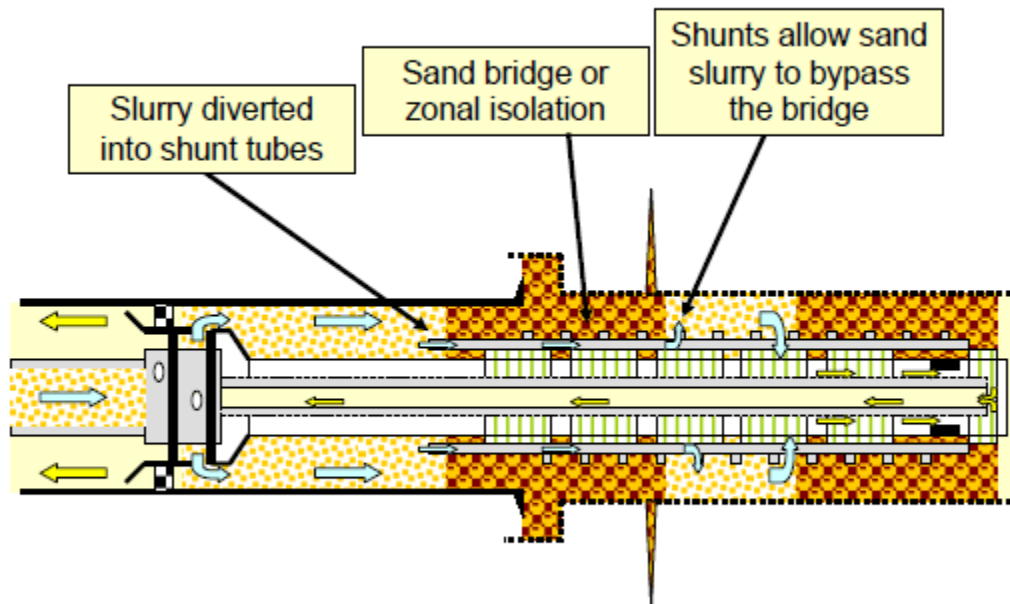


Figure 1 Alternate Path gravel packing with shunt tubes

Figure 1 of Yeh2 shows shunt tubes diverting slurry through distributed portholes to fill annular voids until a complete pack is placed.

Yeh2 explains that “[d]ue to prolonged shunt diversion and higher pressure in extreme length applications, leakoff through a packed packing tube [] may be excessive and could allow gravel accumulation in the manifold.” Ex. 1006, page 5. Yeh2 provides an example “of gravel packing a 5,000 ft horizontal well with the multiple-shunt manifold system.” *Id.*

Figure 15, reproduced below, shows the predicted pressure, rate, and gravel concentration profile in the shunt tubes over the 5,000 ft interval. According to Yeh2, “[b]urst strength of shunt tubes must therefore be capable of accommodating this high hydraulic pressure. *Id.*

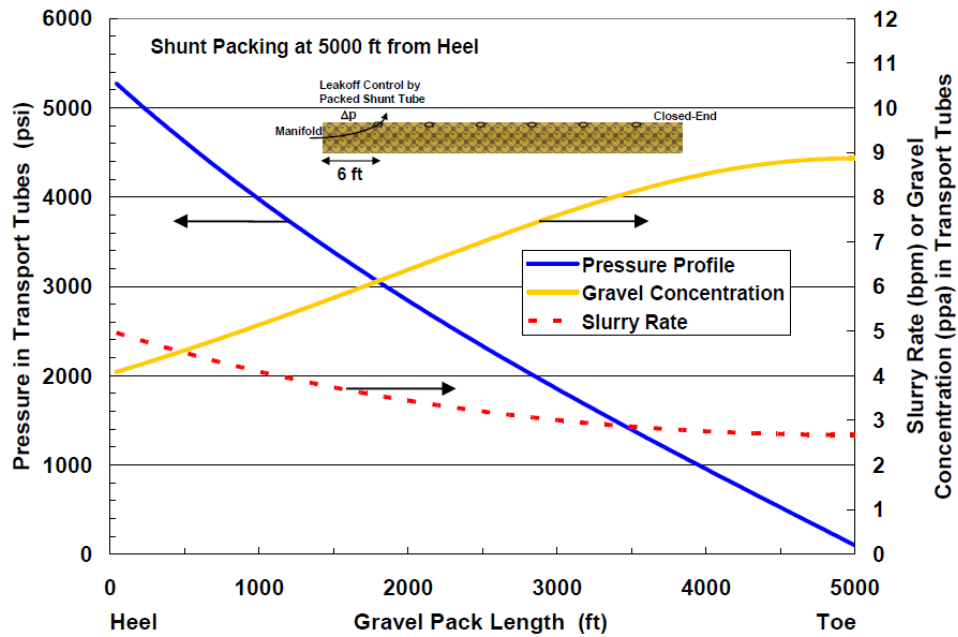


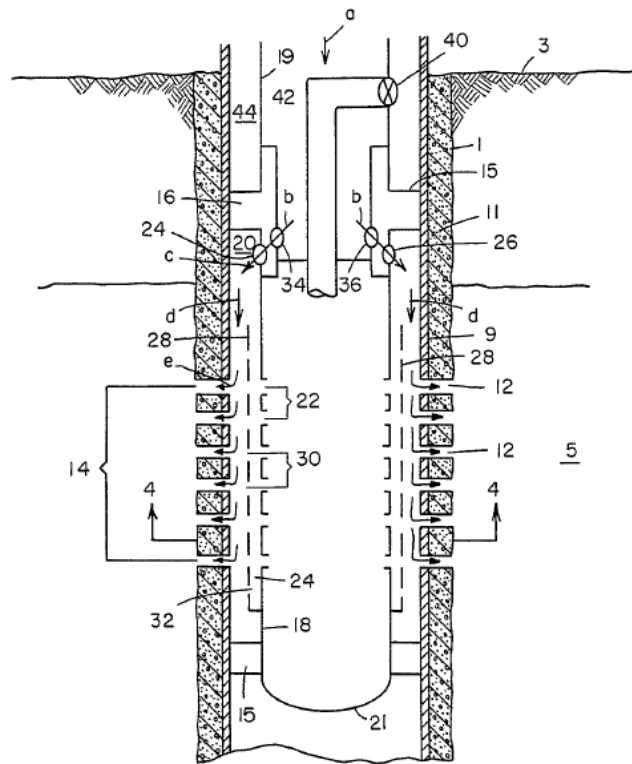
Figure 15 Gravel packing 5,000 ft with multiple-shunt manifold system

Yeh2 Figure 15 shows the predicted pressure, rate, and gravel concentration profile in shunt tubes over a 5,000 ft interval.

3. Jones (Ex. 1007)

Jones is directed to gravel packing a wellbore. Ex. 1007, code (57). Referring, *inter alia*, to Figure 1, reproduced below, Jones explains that a slurry of gravel is injected down a well casing (9) through a work string into a cross-over tool (having a port (40)) in fluid communication with an annular section (44) above a gravel packer (16). *Id.* at 2:36–55.

FIG. 1

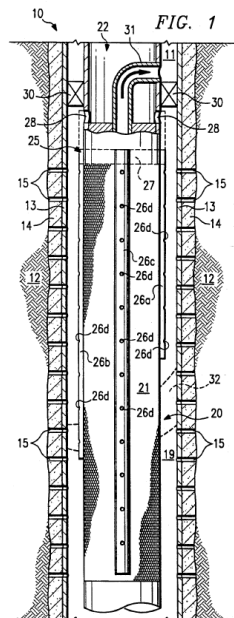


Jones Figure 1 “is a diagrammatic of a perforated well casing at a location of an unconsolidated or loosely consolidated formation illustrating the annular spaces and perforations in the well casing for carrying out the inside of the casing gravel packing method.” Ex. 1007, 2:35–39.

Jones further explains that “a bridge 48 of gravel may occur in the upper portion of annular section 20, thus essentially halting fluid flow through annular section 20.” Ex. 1007, 5:9–11. “By making the cross-sectional area of conduit 28 smaller than the cross-sectional area of annular section 20, the fluid velocity in conduit 28 will be greater than the fluid velocity in annular section 20 thereby preventing bridging of gravel within conduit 28.” *Id.* at 5:17–22.

4. Jones2 (Ex. 1008)

Jones2 describes an apparatus which “is similar” to Jones “but includes shunt means (i.e., conduits and arrangement of conduits) on the external surface of the sand screen which can selectively deliver the gravel slurry to different levels of the interval during the gravel packing operation.” Ex. 1008, 2:24–30. This provides for “an apparatus for gravel packing an interval of a wellbore wherein there is a good distribution of gravel over the entire interval even if a sand bridge or the like is formed in the interval before the placement of the gravel is completed.” *Id.* at 2:20–24. Figure 1 of Jones 2, reproduced below, shows gravel pack apparatus (20) with a sand bridge (32) and shunt means (25) mounted on sand screen (21). *Id.* at 3:36–57.



Jones2 Figure 1 showing a gravel pack apparatus in position within a wellbore.

G. Ground I (claims 1–12): Yeh optionally in view of Yeh2

Petitioner challenges claims 1–12 as unpatentable under 35 U.S.C. § 103(a) over Yeh and optionally Yeh2. Pet. 35–65.

1. Independent claim 1

Claim 1 is reproduced below. Bracketing consistent with the Petition is added to assist in referring to the claim elements. Pet. 32–43.

1. 1[preamble] A completion assembly for deployment in a wellbore, the completion assembly comprising:

1[a] a first sand screen assembly comprising a base pipe having perforations therein and extending between a first end and a second ends, a sand screen disposed around a portion of the base pipe, and a shunt tube assembly disposed outwardly of the sand screen, the shunt tube assembly having a transport tube and a packing tube, where each of the tubes has a passageway defined therein, the packing tube further including a plurality of nozzles spaced apart from each other, wherein each of the tubes and each nozzle has a cross-sectional flow area;

1[b] a second sand screen assembly comprising a base pipe having perforations therein and extending between a first end and a second ends, a sand screen disposed around a portion of the base pipe, and a shunt tube assembly disposed outwardly of the sand screen, the shunt tube assembly having a transport tube and a packing tube, the packing tube including a plurality of nozzles spaced apart from each other, wherein each of the tubes and each nozzle has a cross-sectional flow area;

1[c] a source of pressurized working fluid fluidly coupled to an upstream end of the transport tube of the first sand screen assembly;

1[d] wherein the first and second sand screen assemblies are arranged end to end relative to one another so that the base pipes are in fluid communication with one another and the transport tubes are in fluid communication with one another such

that the transport tube of the second sand screen assembly is fluidly coupled to the source of pressurized working fluid downstream of the transport tube of the first sand screen assembly; and

1[e] 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.

Ex. 1001, 18:17–55

1[preamble]

Petitioner contends that Yeh discloses the preamble, if limiting. Pet. 32 (citing Ex. 1005, 1:28–32; Ex. 1003 ¶¶ 256-259).

The preamble calls for a completion assembly for deployment in a wellbore.

Consistent with Petitioner’s contention, Yeh teaches that its “invention relates to the completion of wellbores using sand screens and gravel packs.” Ex. 1005, 1:27–28; Pet. 32. Mr. Chambers adds that “Yeh’s downhole tool connecting eccentric flow paths to concentric flow paths constitutes a completion assembly [and] . . . refers to the assembly as a ‘downhole tool’.” Ex. 1003 ¶ 258. “[A] POSITA would understand [this] to use downhole in a wellbore.” *Id.*

Given said disclosure and supporting testimony, at this stage, Petitioner sufficiently shows on this record that Yeh discloses the preamble.⁵

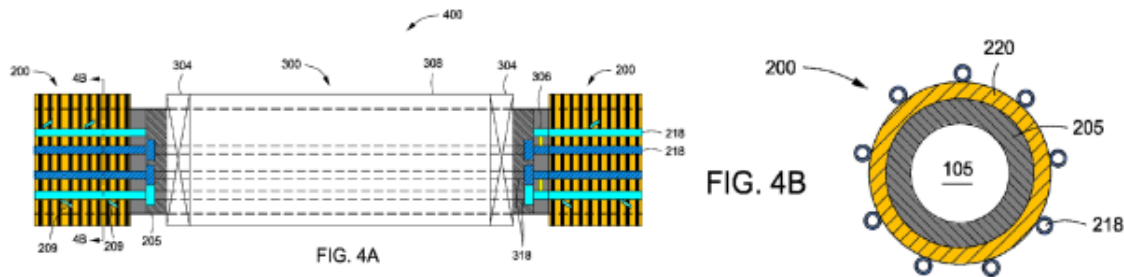
⁵ At this stage of the proceeding, we do not determine whether the preamble is limiting.

1[a]

Petitioner contends that Yeh discloses limitation 1[a]. Pet. 33–34 (citing, *inter alia*, Ex. 1003 ¶¶ 260–70).

Limitation 1[a] calls for a “first sand screen assembly” comprising a “base pipe” with perforations, a “sand screen,” and a “shunt tube assembly.”

To help show that Yeh discloses these elements, Petitioner provides an annotated version of Yeh Figures 4A and 4B, reproduced below. Pet. 33.



Petitioner’s annotated version of Yeh Figures 4A (on the left) and 4B (on the right) showing cross-sectional side views of Yeh’s zonal isolation apparatus 400 comprising “sand screen” 200 (highlighted in orange) wrapping around base pipe 205 (highlighted in dark gray) with external shunt tubes 218 (top and bottom) (highlighted in light blue) and shunt tubes 218 (middle two) (highlighted in blue). Pet. 33; Ex. 1005, 15:53–16:42, Figures 4A, 4B.

Petitioner contends that Yeh’s “concentric screens” 200 (orange), which are attached to both ends of “packer 300,” “would be the first sand screen assembly.” Pet. 33 (citing, *inter alia*, Ex. 1005, 15:53–54, 16:1–4; Ex. 1003 ¶¶ 264–65).

For the “base pipe” and “sand screen,” Petitioner directs us to screen 200 (orange) that is disposed around a portion of base pipe 205 (dark gray) and explains that base pipe 205 has perforations and first and second ends.

Pet. 34 (citing, *inter alia*, Ex. 1005, 11:11–12, 15:53–58, 16:1–12, Figures 1, 2, 4A; Ex. 1003 ¶¶ 266, 268.)

Mr. Chambers explains that a

POSITA would understand that outer mesh 220 [*see* Figure 4B] is a screen. [Ex. 1005] at 16:10-12 (“The outer mesh 220 preferably comprises a wire mesh or wires helically wrapped around the base pipe 205, and serves as a screen.”). Yeh discloses that the screen only covers a portion of the base pipe. EX1005 at Fig. 2 (showing partial coverage of the sand screens over the base pipes), Fig. 4A (same).

Ex. 1003 ¶ 266. Mr. Chambers further explains that the base pipe 205 “receives production fluids through its perforations from the surrounding formation.” Ex. 1003 ¶ 268 (citing Ex. 1005, 11:9-11, 16:5-6).

As can be seen in Figures 1 and 2 [Ex. 1005], the sand screens themselves are essentially joints of tubing each with first and second ends of the base pipe 205 as shown for example in interval 116 in Figure 2. [Ex. 1005] at 11:11-14 (“The base pipe 205 typically is made up of a plurality of pipe joints. The base pipe 205 (or each pipe joint making up the base pipe 205) typically has small perforations or slots to permit the inflow of production fluids.”), Fig. 2.

Id.

For the “shunt tube assembly,” Petitioner directs us to Yeh’s shunt tubes 218; that is, packing (light blue) and transport (light blue) tubes that are external to screen 200 and “have a passageway with a cross-sectional area defined therein to permit flow as shown in Figure 4B.” Pet. 34 (citing, *inter alia*, Ex. 1005, 4:47–48, 4:53–56-15:60–64, 16:38–39, Fig. 4A; Ex. 1003 ¶¶ 269-70). Petitioner contends that “Figure 4A show[s] Yeh’s ‘packing tubes’ 218 have multiple ‘ports or nozzles’ 209.” *Id.* (citing Ex. 1005, 15:60–64, Figure 4A; Ex. 1003 ¶ 269). According to Petitioner,

“[p]orts, nozzles, and tubes inherently have an internal cross-sectional area.” *Id.* (citing Ex. 1003 ¶ 269). Petitioner also notes (in the discussion of limitation 1[b]) that the packing tubes are “spaced apart.” *Id.* at 35 (citing Ex. 1005, Figure 4A; Ex. 1003 ¶ 275).

In support, Mr. Chambers testifies that “Yeh discloses that shunt tubes include both packing and transport tubes. For example, Yeh discloses that ‘[t]he selective shunt tubes 218 on the sand control devices 200 include ports or nozzles or orifices 209, such shunt tubes called packing tubes, to allow flow of gravel slurry between a wellbore annulus and the packing tubes.’ [Ex. 1005, 16:38–39].” Ex. 1003 ¶ 269. “The shunt tubes without nozzles or orifices are referred to as transport tubes (blue in Figure 4A above).” *Id.* ¶ 270 (citing, *inter alia*, Ex. 1005, 16:21–25 (referring to disclosure in U.S. 7,661,476 B2 of a “‘Prior Art’ arrangement for a sand control device wherein packing tubes [] and transport tubes [] are placed external to a base pipe [] and surrounding filter medium []”)). Mr. Chambers also testifies that a “POSITA would understand that the ports, nozzles, and orifices of the packing tubes have an internal cross-sectional area of the opening. Similarly, all shunt tubes (both packing and transport) have a passageway defined inside for flow with a cross-sectional area defined by the shape of the tube, such as rectangular or round.” *Id.* ¶ 269.

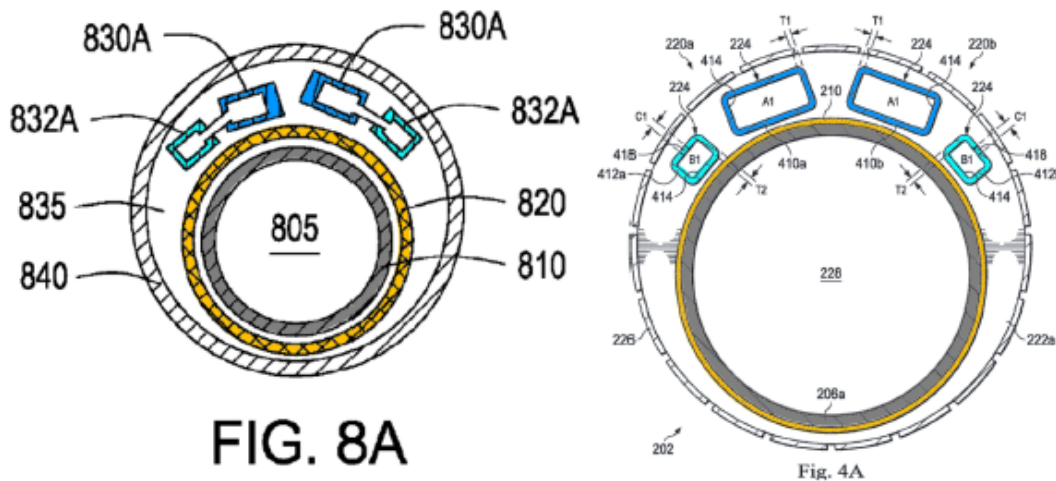
Given said disclosures and supporting testimony, at this stage, Petitioner sufficiently shows on this record that Yeh discloses limitation 1[a].

1[b]

Petitioner contends that Yeh discloses or suggests this limitation. Pet. 34–37 (citing, *inter alia*, Ex. 1003 ¶¶ 271–77).

Limitation 1[b] calls for a “second sand screen assembly” comprising a “base pipe” with perforations, a “sand screen;” and a “shunt tube assembly.”

To help show that Yeh discloses these elements, Petitioner provides an annotated version of Yeh Figure 8A, reproduced below on the left. For comparison, Petitioner also provides an annotated version of Figure 4A of the '700 patent, reproduced below on the right. Pet. 34–35.



Petitioner’s annotated version of Yeh Figure 8A (on the left) showing an eccentric design for a wellbore tool having a bore 805, a filter medium 820 around a base pipe 810, transport tubes 830A (highlighted in blue) and packing tubes 832A (highlighted in light blue). Petitioner’s annotated version of Figure 4A of the '700 patent (on the right) showing a cross-sectional area of first sand screen assembly 202 with shunt tubes 224 A1 (highlighted in blue) and 224 B1 (highlighted in light blue) arranged in eccentric alignment to one side of a sand screen or filter media 210 that is disposed about a portion of base pipe 206 having a series of perforations 208. Pet. 36; Ex. 1005, 24:1–29, Figure 8A; Ex. 1001, 5:14–19, Figure 4A.

Petitioner contends that the eccentric sand screen illustrated in Yeh Figure 8A is like the sand screen assembly illustrated in '007 patent’s Figure

4A and therefore is a “second sand screen assembly” as claimed. Pet. 34–35 (citing Ex. 1001, Figure 4A; Ex. 1005, 30:13–14, Figure 8A; Ex. 1003 ¶ 272).

For the “base pipe” and “sand screen” elements, Petitioner contends that Yeh teaches these elements because it teaches an eccentric screen which “comprises a filter medium 820 [screen] around [a portion of] base pipe 810.” Pet. 35 (quoting Ex. 1005, 24:6–8; citing, *inter alia*, Ex. 1003 ¶ 274).

Mr. Chambers supports Petitioner’s contention by explaining that Yeh teaches that its eccentric screen comprises “a base pipe 810 that defines a bore 805 therein.” Ex. 1003 ¶ 274 (quoting Ex. 1005, 24:4–6, referring to Figure 8A). According to Mr. Chambers, the “base pipes are joints of pipe that a POSITA would understand have a first end and a second end.” *Id.* (citing Ex. 1005, 3:60–62, 11:11–14). And, the “base pipe 205 (or each pipe joint making up the base pipe 205) typically has small perforations or slots to permit the inflow of production fluids.” *Id.* (citing Ex. 1005, Figure 2).

For the “shunt tube assembly,” Petitioner looks to Yeh’s “outside screen 820 and [] transport tubes 830A (blue) and packing tubes 832A (light blue).” Pet. 35 (citing Ex. 1005, 24:15–29, Figure 8A; Ex. 1003 ¶ 275). According to Mr. Chambers, Yeh’s “packing tubes” have “ports or nozzles or orifices” that are spaced apart and have a cross-sectional flow area. Ex. 1003 ¶ 275 (citing Ex. 1005, 15:60–64, Figures 4A, 8A).

Given said disclosures and supporting testimony, at this stage, Petitioner sufficiently shows on this record that Yeh discloses or suggests limitation 1[b].

1[c]

Petitioner contends that “Yeh optionally in view of Yeh2 disclose[s]” limitation 1[c]. Pet. 38–39 (citing, *inter alia*, Ex. ¶¶ 278–84).

Limitation 1[c] requires “a source of pressurized working fluid fluidly coupled to an upstream end of the transport tube of the first sand screen assembly.”

Petitioner contends that 1[c] is taught by Yeh via U.S. 5,588,487 (Ex. 1012) “which is incorporated by reference in Yeh.” Pet. 38–39 (citing Ex. 1005, 3:12–18; Ex. 1003 ¶ 279; Ex. 1012).

Mr. Chambers supports Petitioner’s contention by explaining that Yeh provides a sand screen example where the injected fluid would be a gravel slurry. Ex. 1003 ¶ 279 (citing Ex. 1005, 30:13–14). “A POSITA understood that the only way the fluid would flow down the wellbore against natural formation pressure is if it were pressurized.” *Id.* This is so, according to Mr. Chambers, because a “POSITA understood that gravel slurry pressure comes from a pump.” *Id.* (citing Ex. 1012, 1:30–33). “The pump was located at the surface and delivered its pressurized gravel slurry through a wellhead to the downhole equipment.” *Id.* (quoting Ex. 1005, 1:54–57 (“As part of the completion process, a wellhead is installed at the surface. The wellhead controls the flow of production fluids to the surface, or *the injection of fluids into the wellbore.*”))

Given said disclosures and supporting testimony, at this stage, Petitioner sufficiently shows on this record that Yeh disclose limitation 1[c].

1[d]

Petitioner contends that Yeh discloses limitation 1[d]. Pet. 39–40 (citing, *inter alia*, Ex. ¶¶ 285–89).

Limitation 1[d] requires the first and second sand screen assemblies be arranged “end to end relative to one another so that the base pipes are in fluid communication with one another and the transport tubes are in fluid communication with one another such that the transport tube of the second sand screen assembly is fluidly coupled to the source of pressurized working fluid downstream of the transport tube of the first sand screen assembly.”

Petitioner first contends that Yeh’s “concentric and eccentric screens are the first and second sand screen assemblies, respectively.” Pet. 39 (citing Ex. 1003 ¶ 286). Petitioner then contends that “the concentric and eccentric screens are arranged end-to-end separated by a crossover tool so that their respective base pipes and transport tubes are fluidly connected.” *Id.* (citing Ex. 1003 ¶ 288). Petitioner provides an annotated version of Yeh Figure 10A, reproduced below, to show Yeh’s “[c]rossover tool 1000’s primary flow path 1005 (dark gray) and secondary flow path 1020 (red).” *Id.* at 40 (citing, *inter alia*, Ex. 1005, Fig. 10A, 25:46–55, 25:62–65, 26:42–47; Ex. 1003 ¶ 287).

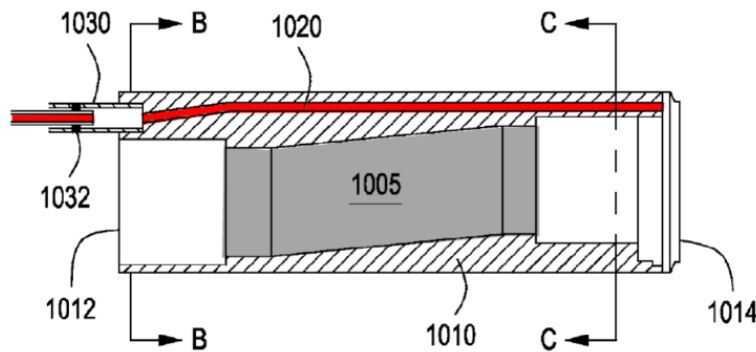


FIG. 10A

Figure 10A is a cross-sectional view of a crossover joint 1000 operating to fluidly connect a first wellbore tool to a second wellbore with a first end 102 and a second end 1014 and a bore 1005 serving as a curved primary flow path. The crossover joint 1000 also has a secondary flow path 1020 (highlighted in red). Ex. 1005, 15:41–55.

Mr. Chambers explains that “Yeh’s crossover tool included a primary and secondary flow path to fluidly connect the base pipes (i.e., the primary flow path) of each screen and the transport tubes (i.e., the secondary flow path) of each screen.” Ex. 1003 ¶ 287. “[T]he pressurized gravel slurry described in claim 1[c] that fluidly coupled to the upstream end of the transport tube of the first sand screen assembly (concentric screen) would flow first through the secondary flow paths of the concentric screen, then through primary and secondary flow paths 1005 and 1020 within the crossover tool, and then into the primary and secondary flow path of the eccentric screen.” *Id.* (citing Ex. 1005, 30:13–14, 25:41–44, 26:35–41, 28:66–29:3, 30:51–67). According to Mr. Chambers, Yeh expressly discloses “the flow sequence of fluid passing through the transport tube of the concentric screen into the crossover tool and then into the transport tube of the eccentric screen” because it describes “injecting the fluid from the

wellbore and through the secondary flow paths of the first wellbore tool, the crossover joint, and the secondary flow paths for the second wellbore tool.” *Id.* (quoting Ex. 1005, 28:66–29:2). Also, according to Mr. Chambers, Yeh teaches the transport tube of the second sand screen assembly is fluidly coupled to the source of pressurized working fluid downstream of the transport tube of the first sand screen assembly because “Yeh disclosed that the fluid (gravel slurry in the sand screen example) flows through the shunt tubes of the first wellbore tool, secondary flow path 1020 of the crossover joint, and shunt tubes of the second wellbore tool.” *Id.*

Given said disclosures and supporting testimony, at this stage, Petitioner sufficiently shows on this record that Yeh discloses limitation 1[d].

1[e]

Petitioner contends that Yeh suggests limitation 1[e]. Pet. 41–43 (citing, *inter alia*, Ex. ¶¶ 290–97).

Limitation 1[e] requires that the transport tube of the first sand screen assembly has a wall thickness greater than the wall thickness of the transport tube of the second sand screen assembly.

Petitioner contends that Yeh discloses that “concentric screen shunt tubes can contain higher pressure than eccentric screens.” Pet. 41 (citing Ex. 1005, 28:10–24). Petitioner further contends that Yeh also discloses “that concentric screens should be placed at the heel, or higher-pressure side, of an interval; whereas, eccentric screens should be placed at the toe, or lower-pressure side.” *Id.* (citing Ex. 1005, 30:13–26; Ex. 1003 ¶ 292). “On the high-pressure side, Yeh disclosed that the shunt tubes (including transport tubes) would have to contain a higher differential pressure, such as 6,500 psi

near the heel in a 5,000-foot horizontal wellbore, than the shunt tubes in the lower-pressure side.” *Id.* (citing Ex. 1005, 28:17–24, 30:16–20; Ex. 1003 ¶ 292). Petitioner points out that Yeh “express disclos[es] that a ‘certain surrounding wall thickness is required’ ‘to stay within the burst, bending, and collapse ratings.’” *Id.* at 42 (quoting Ex. 1005, 28:20–23; citing Ex. 1017, 24 (Equation (14) showing burst pressure roughly directly proportional to wall thickness), Ex. 1003 ¶ 295).

Mr. Chambers provides support, explaining that Yeh “expressly taught that ‘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.’” Ex. 1003 ¶ 291 (quoting Ex. 1005, 28:20–24). According to Mr. Chambers, “a POSITA understood that containing internal pressure within tubing required a certain wall thickness, wall thickness being one of three parameters (wall thickness, tubing material, and tubing outside diameter) that could be adjusted to meet pressure containment requirements.” *Id.* “[A] POSITA would understand that the tubing wall thickness in the eccentric screens would be less than the tubing wall thickness in the concentric screens due to the lower pressure requirement.” *Id.* at ¶ 295.

Given said disclosures and supporting testimony, at this stage, Petitioner sufficiently shows on this record that Yeh suggests limitation 1[e].

2. Conclusion as to claim 1

After considering Petitioner’s position, including the supporting Declaration of Mr. Chambers (Ex. 1003), we are persuaded that, based on the current record, Petitioner has demonstrated a reasonable likelihood of

prevailing on its assertions that the subject matter of claim 1 of the '007 patent would have been obvious over Yeh⁶ and optionally in view of Yeh2.

3. *Claims 2–12*

At this stage of the proceeding, it is unnecessary for us to provide an assessment of claims 2–12 because Petitioner has demonstrated a reasonable likelihood of success in demonstrating that at least one claim (i.e., claim 1) of the '007 patent is unpatentable. *See* 37 C.F.R. § 42.108(a) (2023).

That said, independent claim 11 differs notably from claim 1 in that claim 11 requires, *inter alia*, a “first sand screen assembly compris[ing] a shunt tube assembly with a first *burst pressure* and [a] second sand screen assembly compris[ing] a shunt tube assembly with a *burst pressure* less than the first burst pressure” (11[c]; discussed at Pet. 60) whereas claim 1 calls for the transport tube of the first sand screen assembly to have a first *wall thickness* greater than the *wall thickness* of the transport tube of the second sand screen assembly (1[e]). Ex. 1001, 19:45–50 (11[c]), 18:51–55 (1[e]). Emphasis added.

In that regard, Petitioner relies on its discussion of limitation 1[e]. Pet. 60 (citing Ex. 1003 ¶ 359). In that discussion, Petitioner explained, *inter alia*, that Yeh discloses “concentric screens should be placed at the heel, or higher-pressure side, of an interval; whereas, eccentric screens

⁶ The arguments and evidence presented by Petitioner relative to just Yeh appear to be sufficient to demonstrate a reasonable likelihood that it would prevail in showing the unpatentability of claim 1 over Yeh alone for reasons discussed herein. During trial, we invite the parties to address why one of ordinary skill in the art would not have been led to the subject matter of claim 1 based on Yeh alone.

should be placed at the toe, or lower-pressure side.” Pet. 41 (citing Ex. 1005, 30:13-26; Ex. 1003 ¶ 292). “On the high-pressure side, Yeh disclosed that the shunt tubes (including transport tubes) would have to contain a higher differential pressure, such as 6,500 psi near the heel in a 5,000-foot horizontal wellbore, than the shunt tubes in the lower-pressure side.” *Id.* (citing Ex. 1005, 28:17–24, 30:16–20; Ex. 1003 ¶ 292).

Given said disclosures and supporting testimony, at this stage, Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that the subject matter of claim 11 of the ’007 patent would have been obvious over the combination of Yeh.

H. Ground II (claims 14–20): Yeh in view of Yeh2 and optionally Jones2

Petitioner challenges claims 14–20 as unpatentable under 35 U.S.C. § 103(a) over the combination of Yeh and Yeah2, and optionally Jones2. Pet. 35–75.

At this stage of the proceeding, it is unnecessary for us to provide an assessment of claim 14 and claims 15–20 depending therefrom because Petitioner has demonstrated a reasonable likelihood of success in demonstrating that at least one claim (i.e., claim 1) of the ’007 patent is unpatentable. *See* 37 C.F.R. § 42.108(a).

That said, independent claim 14 differs notably from claim 1 in that claim 14 requires, *inter alia*, a “first sand screen assembly ha[ving] [a] *low pressure* shunt tube system and [a] second sand screen assembly ha[ving] [a] *high pressure* shunt tube system, such that a downstream end of the high pressure shunt tube system is coupled to an upstream end of the low pressure shunt tube system;” (14[e]; discussed at Pet. 67–68) whereas claim 1 calls

for the transport tube of the first sand screen assembly to have a first *wall thickness* greater than the *wall thickness* of the transport tube of the second sand screen assembly (1[e]). Ex. 1001, 19:45–50 (11[c]), 20:21–28 (14[e]). Emphasis added.

In that regard, Petitioner relies on its discussion of, *inter alia*, limitation 1[e]. Pet. 68 (citing Ex. 1003 ¶ 394). Petitioner explains, *inter alia*, that Yeh meets said limitation because it discloses “running [a] completion assembly (concentric screen → crossover tool → eccentric screen)” and “attaching the concentric screen to the eccentric screen” where “Yeh’s eccentric screen has the low-pressure shunt tube system.” *Id.* (citing Ex. 1005, 28:35–36, 28:61–63, 28:40–41, 28:61–63, 30:13–14; Ex. 1003 ¶¶ 390, 392, 395).

Given said disclosures and supporting testimony, at this stage, Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that the subject matter of claim 14 of the ’007 patent would have been obvious over the combination of Yeh and Yeh2.

I. Ground III (claims 21–22): Yeh in view of Jones

At this stage of the proceeding, it is unnecessary for us to provide an assessment of claim 21 and claim 22 depending therefrom because Petitioner has demonstrated a reasonable likelihood of success in demonstrating that at least one claim (i.e., claim 1) of the ’007 patent is unpatentable. *See* 37 C.F.R. § 42.108(a).

That said, independent claim 21 differs notably from claim 1 in that claim 21 requires, *inter alia*, “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*” (21[e]; discussed at Pet. 77–78) whereas claim 1 calls for the transport tube of the first sand screen assembly to have a first *wall thickness* greater than the *wall thickness* of the transport tube of the second sand screen assembly (1[e]). Ex. 1001, 19:45–50 (11[c]), 20:21–28 (14[e]). Emphasis added.

In that regard, Petitioner relies on its discussion of, *inter alia*, limitation 1[e]. Pet. 78 (citing Ex. 1003 ¶ 435; Ex. 1005, 28:17–23). Petitioner explained there that given “Yeh’s express disclosure that a ‘certain surrounding wall thickness is required’ ‘to stay within the burst, bending, and collapse ratings,’ one of skill would have understood that a higher-pressure shunt tube assembly necessitated greater wall thickness.” Pet. 42 (citing Ex. 1005, 28:20–23; Ex. 1017, 24 (stating “Equation (14) showing burst pressure roughly directly proportional to wall thickness”); Ex. 1003 ¶ 295). Mr. Chambers further explains, *inter alia*, that

A POSITA, motivated by reducing material costs where possible as suggested by Yeh, would know that there were only three shunt tube design variables according to Equation (14) that could be used to decrease shunt tube burst pressure: (1) use a lower tensile strength material (decrease f), (2) decrease tubing wall thickness (decrease t), or (3) increase the outside diameter (increase D).

Ex. 1003 ¶ 435 (citing Ex. 1017, 24); Pet. 78.

Given said disclosures and supporting testimony, at this stage, Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that the subject matter of claim 21 of the ’007 patent would have been obvious over the combination of Yeh and Jones.

J. Ground IV (claim 23): Yeh in view of Jones and Yeh2

Petitioner challenges claim 23 as unpatentable under 35 U.S.C. § 103(a) over the combination of Yeh, Jones and Yeh2. Pet. 66–86.

At this stage of the proceeding, it is unnecessary for us to provide an assessment of claims 23, which depends from claim 21, because Petitioner has demonstrated a reasonable likelihood of success in demonstrating that at least one claim (i.e., claim 1) of the '007 patent is unpatentable. *See* 37 C.F.R. § 42.108(a).

III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has demonstrated a reasonable likelihood that it would prevail in showing the unpatentability of at least one of claims 1–12 and 14–23 of the '007 patent. Accordingly, we grant the Petition and institute an *inter partes* review of the '007 patent.

Because a decision to institute is “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition,” *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 & n.2 (Fed. Cir. 2018) (citing *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018) and corresponding USPTO Guidance, <https://www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial> (Apr. 26, 2018)), and because we have determined that at least one ground set forth in the Petition satisfies the threshold for institution, trial is instituted on the proposed grounds.

IV. ORDER

It is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), *inter partes* review of claims 1–12 and 14–23 of the '007 patent is instituted 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), *inter partes* review of claims 1–12 and 14–23 of the '007 patent shall commence on the entry date of this Order, and notice is hereby given of the institution of *inter partes* review.

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