

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DYNAENERGETICS EUROPE GMBH and
DYNAENERGETICS US, INC.,
Petitioner,

v.

SWM INTERNATIONAL, LLC,
Patent Owner.

IPR2022-01372
Patent 11,078,762 B2

Before MITCHELL G. WEATHERLY, ELIZABETH M. ROESEL, and
RICHARD H. MARSCHALL, *Administrative Patent Judges*.

ROESEL, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. *Background and Summary*

DynaEnergetics Europe GmbH and DynaEnergetics US, Inc. (collectively, “Petitioner”) filed a Petition (Paper 1, “Pet.”) seeking an *inter partes* review of claims 1–4, 7, 9, 10, 15–20, 24–26, 29, 30, and 33–36 of U.S. Patent No. 11,078,762 B2 (Ex. 1001, “the ’762 Patent”). SWM International, LLC (“Patent Owner”) filed a Preliminary Response. Paper 6 (“Prelim. Resp.”). With the Preliminary Response, Patent Owner filed a statutory disclaimer of claims 1, 2, 9, 10, 15, 17–20, and 33 of the ’762 Patent. Prelim. Resp. 1; Ex. 2003. We instituted an *inter partes* review of claims 3, 4, 7, 16, 24–26, 29, 30, and 34–36, which are the challenged claims remaining in the ’762 Patent after Patent Owner’s statutory disclaimer. Paper 7 (“Institution Decision” or “Inst. Dec.”).

After institution, Patent Owner filed a Response (Paper 11, “PO Resp.”), Petitioner filed a Reply (Paper 15, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 21, “PO Sur-reply”). We held an oral hearing on November 15, 2023, and a transcript is in the record. Paper 26 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). We determine that Petitioner has shown by a preponderance of the evidence that some of the challenged claims of the ’762 Patent are unpatentable. Briefly, in summary, Petitioner shows that claims 3, 7, 24–26, 29, 30, and 34–36 are anticipated by two separate references—Yonghong and Hardesty—but does not meet its burden to show that claims 4 and 16 would have been obvious in view of either of these references in combination with either Schacherer or Eitschberger.

B. Related Matters

The parties identify the following district court case as a related matter: *SWM International, LLC v. DynaEnergetics Europe*, 6:21-cv-00804-ADA (W.D. Tex.). Pet. 1; Paper 5, 1 (Patent Owner's mandatory notices).

C. The '762 Patent (Ex. 1001)

The '762 Patent was issued August 3, 2021, on an application filed March 5, 2019, which is the effective filing date.

The '762 Patent discloses a downhole perforating gun tube for use in oil and gas production. Ex. 1001, codes (54) (57), 1:11–31.

Figure 1 is reproduced below.

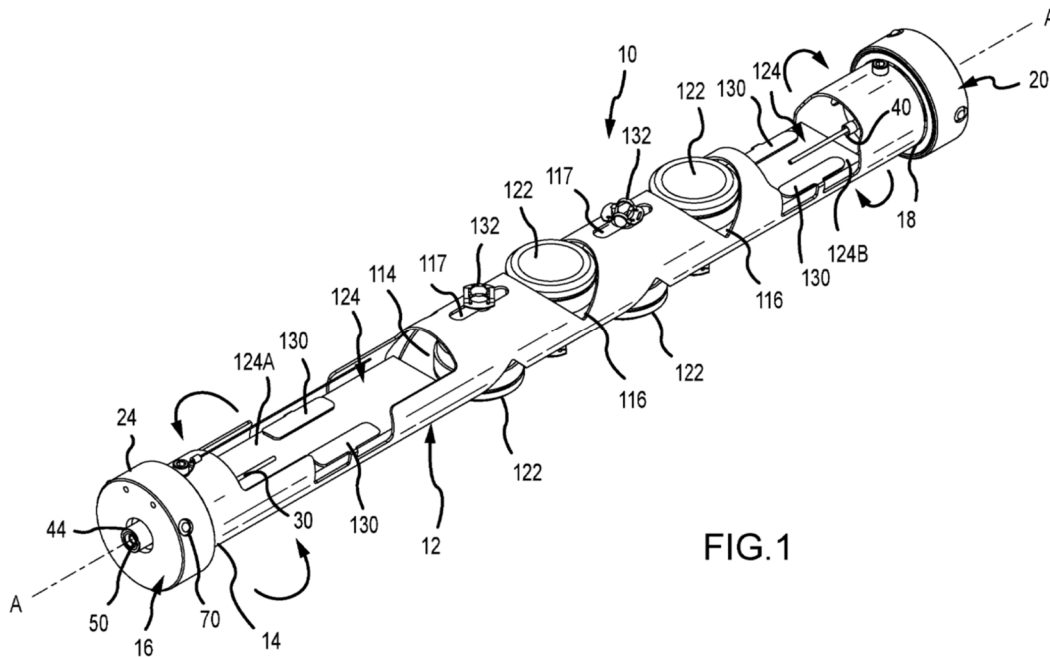
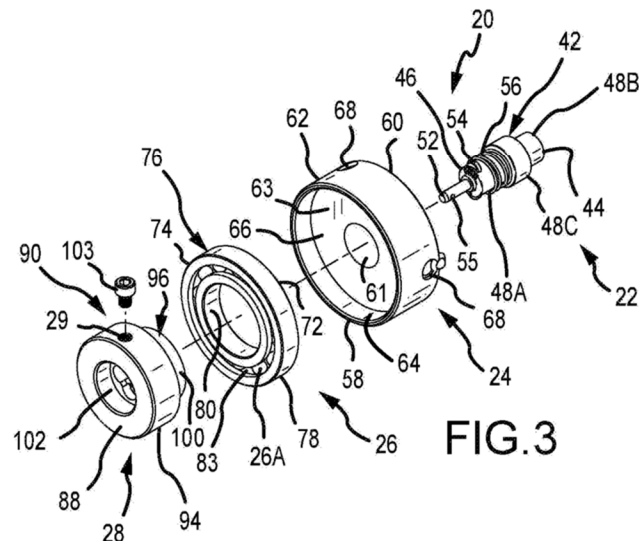
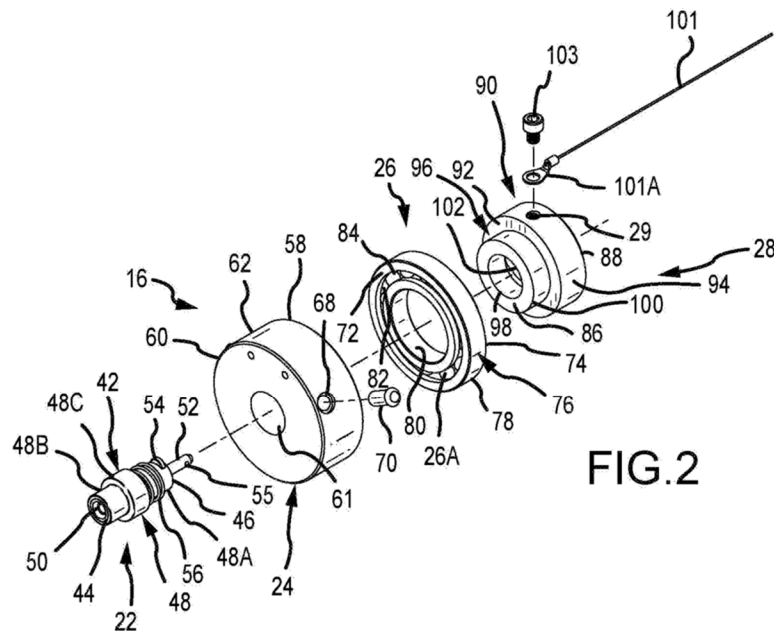


Figure 1 of the '762 Patent shows perforating gun tube 10, including tube body 12, first end fitting or cap 16, second end fitting or cap 20, electrical contact 50, shaped or explosive charges 122, and weights 124A and 124B. Ex. 1001, 2:66–67, 5:50–6:3.

Figures 2 and 3 are reproduced below.



Figures 2 and 3 of the '762 Patent are exploded views of the first and second end caps of the gun tube. Ex. 1001, 3:1–4. Each end cap includes end contact 22, outer collar 24, bearing assembly 26, support 28, and electrical contact 50. *Id.* at 6:56–7:1. Outer collar 24 is positioned over end contact 22, bearing assembly 26, and support 28, so that electrical contact 50 extends through an opening 61 of outer collar 24. *Id.* at 8:50–53, Fig. 2.

The '762 Patent discloses that weights 124 “cause gun tube 10 to rotate relative to bearing assemblies 26 so the portion of gun tube 10 that retains one or more weights 124 is at the bottom of the wellbore (i.e., closest to the Earth’s center) when gun tube 10 is positioned horizontally in a wellbore.” Ex. 1001, 6:5–10. Rotation of the gun tube, coupled with the location and angle of the weights in the gun tube, allows the shape charges to be oriented in a desired direction prior to the shape charges being fired. *Id.* at code (57), 6:37–52.

D. Illustrative Claim

Claims 3, 4, 7, 16, 24–26, 29, 30, 34–36 are the challenged claims that remain in the '762 Patent after Patent Owner’s statutory disclaimer. Claims 24 and 29 are independent, and claim 24 is illustrative of the claimed subject matter.

24. A downhole perforating gun system, comprising: an outer casing having a longitudinal center axis;

a gun body having a longitudinal center axis, wherein the gun body is concentrically disposed in the outer casing such that the longitudinal center axis of the gun body is aligned with the longitudinal center axis of the outer casing;

one or more explosive charges coupled to the gun body;

a collar;

a support member;

a bearing assembly at least partially disposed between the collar and the support member such that the gun body is rotatable relative to the outer casing; and

one or more weights, wherein the gun body is rotatable by the weights via the bearing assembly based on gravity acting on the one or more weights.

Ex. 1001, 27:55–28:3.

E. Asserted Challenges to Patentability

Petitioner asserts the following challenges to patentability:

Claims Challenged¹	35 U.S.C. §	Reference(s)/Basis
3, 7, 24–26, 29, 30, 34–36	102(a)(1)	Yonghong ²
4, 16	103	Yonghong, Schacherer ³
4, 16	103	Yonghong, Eitschberger ⁴
3, 7, 24–26, 29, 30, 34–36	102(a)(1)	Hardesty ⁵
4, 16	103	Hardesty, Schacherer
4, 16	103	Hardesty, Eitschberger
3, 7, 24–26, 29, 30, 34–36	103	Hardesty, Yonghong

Pet. 4.

F. Testimonial Evidence

The record includes initial and reply declarations of John Rodgers, Ph.D., submitted by Petitioner (Exs. 1003, 1019) and Dr. Rodgers’ deposition testimony submitted by Patent Owner (Exs. 2008, 2010). The record also includes first and second declarations of Gary R. Wooley, Ph.D., filed by Patent Owner (Exs. 2001, 2007) and Dr. Wooley’s deposition testimony filed by Petitioner (Ex. 1018).

¹ Here and throughout the Decision, we list only the challenged claims remaining in the ’762 Patent after Patent Owner’s statutory disclaimer.

² Ex. 1004, CN2698970Y, granted May 11, 2005, with English Translation (“Yonghong”).

³ Ex. 1006, US 9,689,223 B2, issued June 27, 2017 (“Schacherer”).

⁴ Ex. 1007, US 9,784,549 B2, issued October 10, 2017 (“Eitschberger”).

⁵ Ex. 1005, US 9,115,572 B1, issued August 25, 2015 (“Hardesty”).

II. ANALYSIS

A. Legal Standards

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). 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 at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved based on 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 presented, objective evidence of nonobviousness, i.e., secondary considerations.⁶ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

⁶ In this case, neither party addresses objective evidence of nonobviousness.

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

B. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art (“POSITA”) would have had “a Bachelor of Science in mechanical or electrical engineering and 2–5 years of experience designing perforating gun systems.” Pet. 25. According to Petitioner, “[t]he individual should be familiar with prior art methods of using gravity to orient the shaped charges in a rotatable charge tube.” *Id.* Petitioner further contends that “[p]ersons with different degrees may also have ordinary skill in the art, and increased education or experience could compensate for shortcomings in other areas.” *Id.* (citing Ex. 1003 ¶ 51).

Patent Owner does not dispute Petitioner’s definition of the level of ordinary skill in the art. PO Resp. 7–8.

We apply Petitioner’s articulation of the level of ordinary skill in the art, which is consistent with the level of skill in the art at the time of the invention as reflected in the Specification of the ’762 Patent and the asserted prior art.

C. Claim Construction

In an *inter partes* review, we apply the same claim construction standard as would be used by a district court to construe a claim in a civil action involving the validity or infringement of a patent. 37 C.F.R. § 42.100(b). Under that standard, claim terms are given their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–19 (Fed. Cir. 2005) (en banc); *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012). “The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (quoting *Vivid Techs., Inc. v. Am. Sci. Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

In the related litigation, the district court ruled that the term “collar” has its “[p]lain and ordinary meaning” and “does not inherently require or restrict rotation.” Ex. 1008.⁷ Petitioner states that it does not contest this construction. Pet. 26. Patent Owner asserts that, in the related litigation, the parties and their respective experts agreed that “a collar is an annular or ring-shaped structure.” PO Resp. 8 (citing Ex. 1009, 2–3; Ex. 2001 ¶¶ 38–42). Petitioner does not dispute that a collar is annular or ring-shaped. *See* Pet.

⁷ The district court also ruled that the term “predefined orientation” has its “[p]lain and ordinary meaning” and is “[n]ot indefinite. Ex. 1008. In the meantime, however, Patent Owner disclaimed claim 20, the only claim in which this term appears.

Reply 4–6 (arguing that Yonghong discloses a collar, without disputing Patent Owner’s definition).

In the Institution Decision, we agreed with Patent Owner’s proposed construction for the term “collar.” Inst. Dec. 10. Because Patent Owner’s proposed construction is undisputed and supported by the ’762 Patent’s description of “outer collar 24” as having “annular side wall 62” (Ex. 1001, 7:59–63, Fig. 3), we construe a “collar” as “an annular or ring-shaped structure.”

Next, Patent Owner argues that “the claimed ‘gun body,’ ‘collar,’ ‘support member,’ and ‘one or more weights’ are required to be separate from each other and also from the other elements of the remaining claims.” PO Resp. 8 (citing Ex. 2001 ¶ 43). As evidentiary support for this argument, Patent Owner relies on the language of the claims, descriptions in the Specification, the district court’s construction for the term “collar,” and Dr. Wooley’s testimony. *Id.* at 8–12 (citing Ex. 1001, 1:49–54, 1:65–2:6, 8:9–36, 8:63–66, Figs. 4, 13A–13J; Ex. 1008; Ex. 2001 ¶¶ 38–50).

Patent Owner is correct that, “[w]here a claim lists elements separately, the clear implication of the claim language is that those elements are distinct components of the patented invention.” *Becton, Dickinson & Co. v. Tyco Healthcare Group, LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010) (internal quotations omitted). The Court held that “[b]ecause the unequivocal language of the asserted claims . . . requires both a hinged arm and a spring means, there can be no literal infringement by [the] accused products which . . . do not contain a spring means that is a separate structural element from the hinged arm and its hinges.” *Id.* at 1255–56.

After considering Patent Owner’s claim construction argument, we determine that it is best addressed in the context of considering whether the asserted prior art anticipates the challenged claims.

D. Anticipation by Yonghong

Petitioner challenges claims 3, 7, 24–26, 29, 30, and 34–36 as anticipated by Yonghong. Pet. 26–47. Patent Owner opposes. PO Resp. 16–19. We begin our analysis with an overview of Yonghong.

1. Yonghong (Ex. 1004)

Yonghong is a utility model titled “Perforating Gun for Horizontal Well.” Ex. 1004, code (54). Figure 1 is reproduced below.

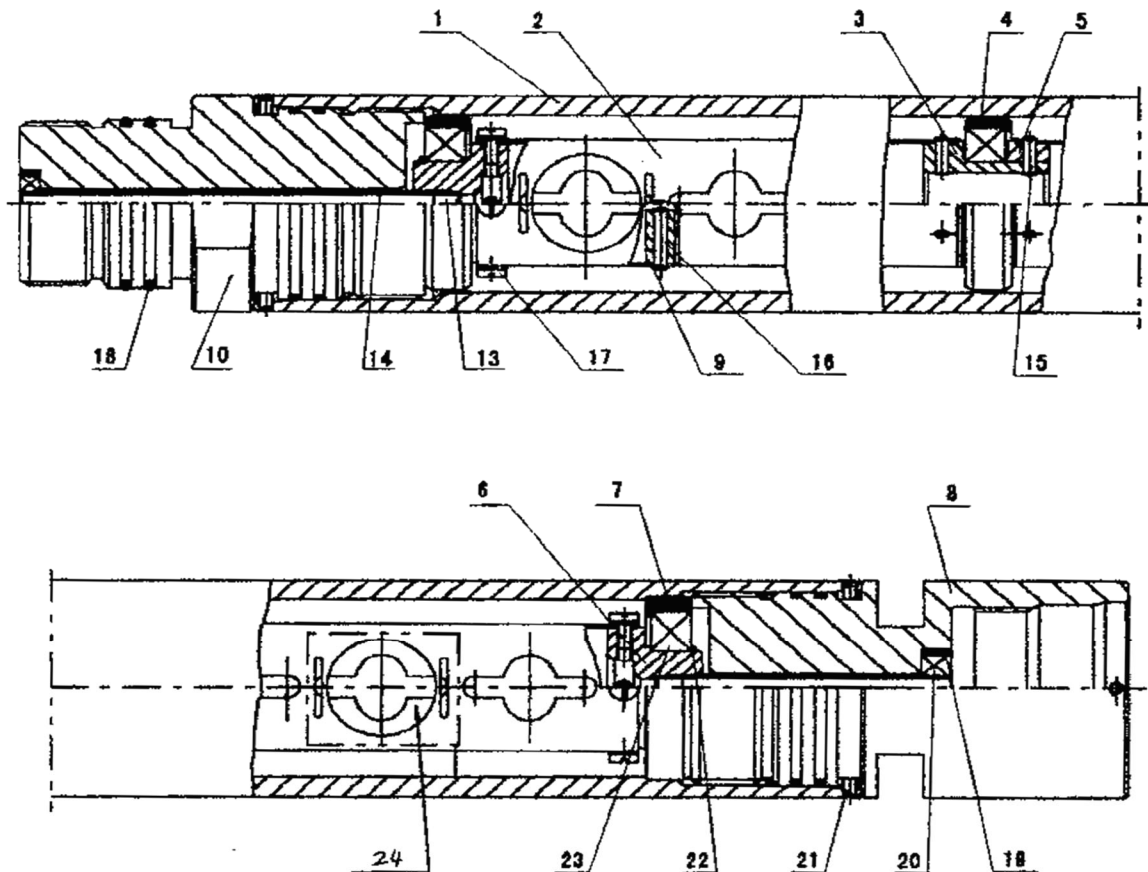


Fig. 1

Yonghong Figure 1 shows a gun body of a perforating gun, including gun tube 1, upper connector 8, and lower connector 10. Ex. 1004, 6–8.⁸ With reference to Figure 1, Yonghong discloses:

The charge tube assembly has an internal directional rotation structure which uses an eccentric weight principle to determine the perforation direction of the charge tube assembly; the three charge tubes sections (2) are connected by means of a shaft (3), a sleeve (5), and a self-plugging rivet (15); a charge tube shaft (6) is connected to the charge tube (2) by means of a screw (17); a counterweight (9) is mounted at the bottom of the charge tube (2) by means of a self-plugging rivet (16); a bearing (23), a bushing (4), a bearing seat (7), and a retaining ring (22) are respectively mounted at the connection of the shaft (3) and the sleeve (5) and at the charge tube shafts (6) at both ends.

The safe detonation propagation mechanism has a structure enabling the detonating cord to rotate together with the charge tube assembly; after the detonating cord penetrates through the inner holes of the charge tube shafts (6) at the two ends of the charge tubes (2), first, a backstop tube (13) is used to close the hole, and then one end of the detonating cord protection tube (14) is connected to the charge tube shaft (6), and the other end penetrates through the small bearings (20) and a retaining ring (19) mounted in an upper and lower connector (8, 10), after which it is intermediately abutted with one end of the detonating cord protection tube (14) at the other end.

Id. at 6 (excerpt from “summary” section of Yonghong); *see also id.* at 8–9 (essentially the same text in the “detailed description of the embodiments”). Yonghong discloses that, with this design, “the charge tube assembly in each perforating gun can rotate continuously to adjust with the change of well bore trajectory” and “the detonating cord can rotate together with the charge

⁸ We refer to the page numbers added by Petitioner in the bottom right corner of each page of Exhibit 1004.

tube assembly,” which “produces more reliable detonation propagation and better alignment.” *Id.* at 9.

2. Yonghong Discloses a Collar

Challenged claims 3, 24, and 29 each recites a collar. Claim 24, for example, recites “a collar; a support member; a bearing assembly at least partially disposed between the collar and the support member such that the gun body is rotatable relative to the outer casing.”

Petitioner maps the recited “collar” to Yonghong’s “bushing (4)” and directs us to Yonghong’s disclosure that “bushing (4)” is “mounted at the . . . charge tube shafts (6) at both ends.” Pet. 30 (citing Ex. 1004, 6, 8, Fig. 1, claim 5; Ex. 1003 ¶¶ 62, 63). Petitioner illustrates its contention with the following annotated version of Yonghong Figure 1:

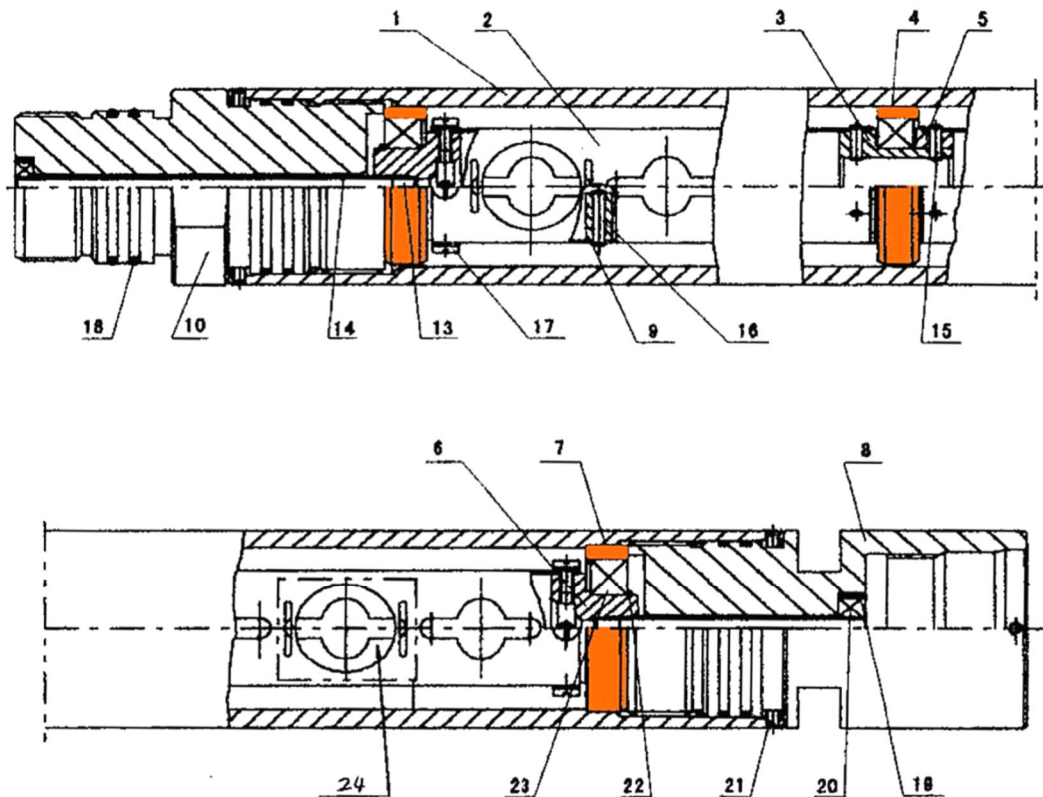


Fig. 1

Pet. 31. Yonghong Figure 1 shows a gun body of a perforating gun. In Petitioner's annotation, three structures are colored orange to identify the alleged "collar."

Patent Owner argues that "Yonghong contains no explicit disclosure of any component that could constitute a collar within the meaning of the '762 Patent," and "the disclosure of Yonghong is ambiguous." PO Resp. 16 (citing Ex. 2001 ¶ 55). Quoting Dr. Wooley's testimony, Patent Owner argues, "There is simply no disclosure in Yonghong that would unambiguously communicate to one of ordinary skill in the art that the bushing shown in Figure 1 is an annular structure." *Id.* at 19 (quoting Ex. 2007 ¶ 17).

We are persuaded by Petitioner's contention that Yonghong discloses a "collar," as recited in the claims. Petitioner identifies Yonghong's bushing 4 as the recited "collar." Pet. 30–31. As discussed below, the evidence shows that bushing 4 is annular or ring-shaped, as set forth in our claim construction.

In the Institution Decision, we provided our preliminary understanding of Yonghong's disclosure as it pertains to bushing 4. Inst. Dec. 15. Neither party disputes that understanding, which we reiterate in the paragraph below as our findings in this Decision, based on our review of the complete trial record.

Yonghong discloses a charge tube assembly having a total of four bushings 4: two "at the connection of the shaft (3) and the sleeve (5)" between the charge tubes sections (of which there are three) and two more "at the charge tube shafts (6) at both ends." Ex. 1004, 6, 8. Three of these bushings are shown in Yonghong Figure 1, even though only one of them is labeled with a reference numeral. The same is true for bearing seat 7.

Furthermore, Yonghong Figure 1 shows annular structures, including bushing 4, with one quarter of the annular structure cut away to show a longitudinal cross section on the upper half of each of the upper and lower parts of the drawing. *Id.*, Fig. 1. *See* Inst. Dec. 15.

Our understanding of Yonghong Figure 1 is supported by Petitioner's expert, Dr. Rodgers, who provided a 3-D CAD (three-dimensional computer aided design) model based on Yonghong's disclosure. Ex. 1003 ¶ 38.

Dr. Rodgers' 3-D CAD model shows an annular or ring-shaped structure corresponding to Yonghong's bushing 4. *Id.* At his deposition, Dr. Rodgers explained that Yonghong Figure 1 shows some parts as "half model cuts," other parts as "a quarter cut-away," and still other parts in "full circumference," i.e., "[t]hey're not cut at all." Ex. 2008, 37:11–20. The gun carrier is shown as a half cut, and the bushing 4 is shown as a quarter-cut. *Id.* at 57:24–58:11, 65:3–12. Referring to bushing 4 in Yonghong Figure 1, Dr. Rodgers explained that "[a] person of ordinary skill looks at that and understands it's a quarter-cut model, and that's one continuous part, a ring that wraps around the bearing." *Id.* at 65:13–22; *see also* 60:17–24 ("A bushing or a collar slides around the outside of the bearing, or another way to say it is the bearing fits within that bushing or collar to mount it in the carrier."). According to Dr. Rodgers, there is no need for the text of Yonghong to include this description "because a person of ordinary skill looks at this v[e]ry standard drawing and understands what it is." *Id.* at 60:25–61:2.

We have considered the testimony Patent Owner cites to support its argument that Yonghong is ambiguous. PO Resp. 16–17 (citing Ex. 2007 ¶¶ 16–18, 46; Ex. 2008, 34:22–35:10, 36:1–15, 49:19–50:1, 52:8–15, 53:17–54:12). The cited testimony does not undermine our finding that

Yonghong's that bushing 4 is annular or ring-shaped. Although Dr. Rodgers testified that some parts of Yonghong Figure 1 are not depicted clearly and "some people have trouble reading these figures" (Ex. 2008, 34:22–35:10, 49:19-50:1), he never wavered from his understanding that Yonghong's bushing 4 is "a ring that wraps around the bearing" (*id.* at 65:13–22). According to Dr. Rodgers, there is no ambiguity and "[t]here's only one correct way to read this drawing." *Id.* at 39:15–20 (discussing Yonghong Figure 1). Dr. Wooley, on the other hand, provided no plausible interpretation of Yonghong's bushing 4 that is not annular or ring-shaped. Dr. Wooley testified it is "possible that the bearings, bushing(s), and bearing seats in Yonghong are not annular but are instead formed in sections that do not cover the entire circumference." Ex. 2007 ¶ 16. But that testimony is based on an incorrect assumption that Yonghong's shaft is not continuously rotating and has a limited rotational range of motion. *Id.*; *see also* PO Resp. 17 (arguing that Yonghong does not disclose a continuously rotating shaft). Contrary to Dr. Wooley's assumption and Patent Owner's argument, Yonghong discloses that "the charge tube assembly in each perforating gun can rotate continuously to adjust with the change of well bore trajectory." Ex. 1004, 9.

At the hearing, Patent Owner argued, "there's testimony from Dr. Wooley that in order to have the 360-degree rotation that Yonghong talks about, you could have a partial ring." Tr. 30:7–12 (referring to Patent Owner's slide 35, which quotes Ex. 1018, 163:3–13). Contrary to Patent Owner's argument, Dr. Wooley did not agree that Yonghong discloses 360-degree rotation. In both his declaration and deposition testimony, Dr. Wooley maintained that "continuous rotation" is "not how this design works." Ex. 1018, 83:16–84:13, 87:21–88:7, 89:20–91:2; Ex. 2008 ¶ 16. In

the testimony Patent Owner referenced at the hearing, Dr. Wooley answered a hypothetical question.

Q And if the structure had a bushing that was not fully annular, could the charge [tube] assembly in Yonghong still rotate 360 degrees? . . .

A Sorry. Yes, there's nothing that would keep it from rotating. It's certainly possible to not have a full 360-degree ring in order to allow rotation throughout the 360 degrees.

Ex. 1018, 163:3–13 (objection omitted). The question assumes the bushing is not fully annular, and Dr. Wooley's answer does not correct his unsupported interpretation of Yonghong as not disclosing continuous rotation. Ex. 1018, 83:16–84:13, 87:21–88:7, 89:20–91:2; Ex. 2008 ¶ 16. And Dr. Wooley's testimony that “annular bearings are common in certain applications with continuously rotating shafts” (Ex. 2007 ¶ 16) supports Petitioner's view that Yonghong's bushing 4 is annular. Pet. 30–31; Pet. Reply 5–6; Ex. 2008, 60:17–61:2, 65:13–22.

In sum, the record provides ample evidence that Yonghong's bushing 4 is annular or ring-shaped.

3. *Remaining Elements and Conclusion*

Based upon Petitioner's undisputed showing, we find that Yonghong discloses all remaining limitations of claims 3, 7, 24–26, 29, 30, and 34–36. Pet. 26–36, 38–39, 44–47; Ex. 1003 ¶¶ 57–70, 75–78, 85–99; *see* PO Resp. 16–19 (arguing that Yonghong does not disclose a collar and presenting no other argument addressing Petitioner's Yonghong anticipation ground).

We conclude that Petitioner has shown by a preponderance of the evidence that claims 3, 7, 24–26, 29, 30, and 34–36 are anticipated by Yonghong.

E. Anticipation by Hardesty

Petitioner challenges claims 3, 7, 24–26, 29, 30, and 34–36 as anticipated by Hardesty.⁹ Pet. 60–80. Patent Owner opposes. PO Resp. 19–22. We begin our analysis with an overview of Hardesty.

1. Hardesty (Ex. 1005)

Hardesty discloses a system and method for orienting a perforating gun in a wellbore. Ex. 1005, 1:37–41. The system includes a gun string assembly (“GSA”) with an external protuberance member (“EPM”) and an internal pivot support (“IPS”). *Id.* at code (57), 4:27–30. The EPM orients the GSA within a coarse angular range, and the IPS corrects the orientation within a fine angular range. *Id.* at 4:44–56. According to Hardesty, “[t]he external orientation of the EPM along with limited internal swing about the IPS provide for an accurate orientation of the charges for perforating through a hydrocarbon formation.” *Id.* at 4:37–40.

Figure 4 is reproduced below.

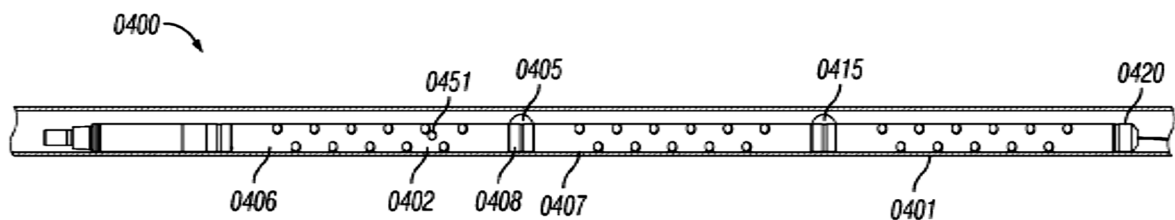


FIG. 4

⁹ Petitioner’s Hardesty anticipation challenge is separate and independent from Petitioner’s Yonghong anticipation challenge. Although the same challenged claims are at issue, we address both challenges because they provide the basis for Petitioner’s obviousness challenges discussed below.

Hardesty Figure 4 shows GSA 20 deployed inside wellbore casing 1.¹⁰ Ex. 1005, 6:39–48. GSA 20 includes a string of perforating guns 6 connected by finned subs 8, to which EPM 5 is attached. *Id.* at 6:50–61. According to Hardesty, EPM 5 externally orients GSA 20 in the well casing such that the charges inside a charge holder tube (“CHT”) “are coarsely aligned within ± 20 degrees (coarse angular range) of the desired perforating orientation.” *Id.* at 6:57–7:2.

Figure 7 is reproduced below.

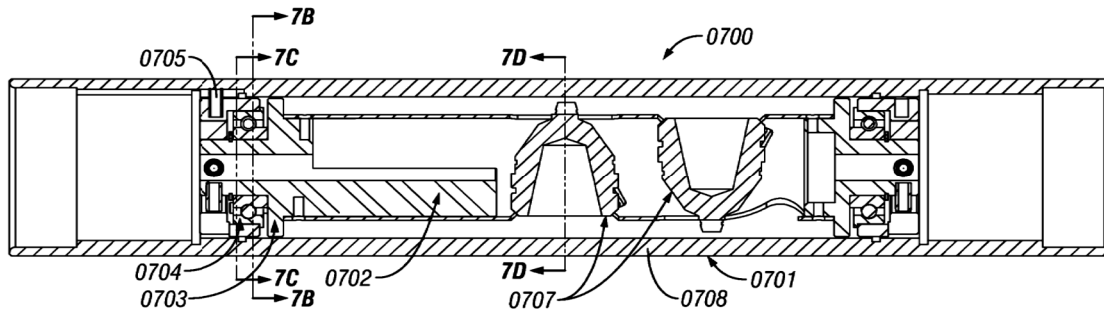
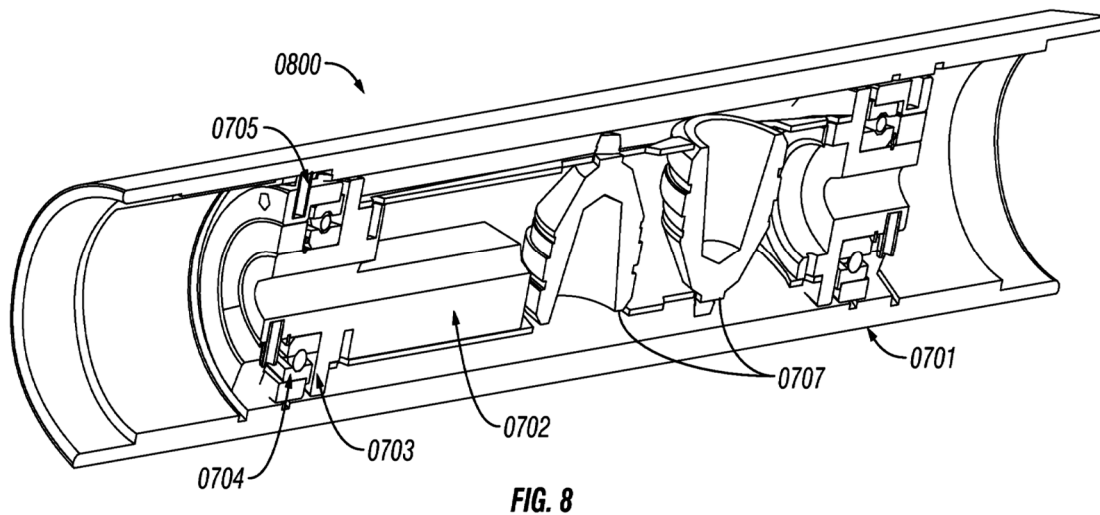


FIG. 7

Hardesty Figure 7 shows perforating gun 1 comprising CHT 3, which carries energetic charges 7, 8 and is coupled to the gun via bearing race system 4 and aligned to the gun barrel with alignment pin 5. Ex. 1005, 8:54–63. According to Hardesty, a pin in bearing race system 4 limits the rotation of CHT 3 within a limited arc and orients energetic charges 7, 8 within a fine angular range, for example, within ± 5 degrees. *Id.* at 8:63–9:5, 9:9–12, Fig. 7C (cross-section showing restriction pin 31). Eccentric weight 2 “may also be used to orient the energetic charges in a preferred perforating direction.” *Id.* at 9:12–14.

¹⁰ For simplicity, we omit the first two or three digits of Hardesty’s reference numerals, for example, “20” instead of “0420” and “1” instead of “0401.”

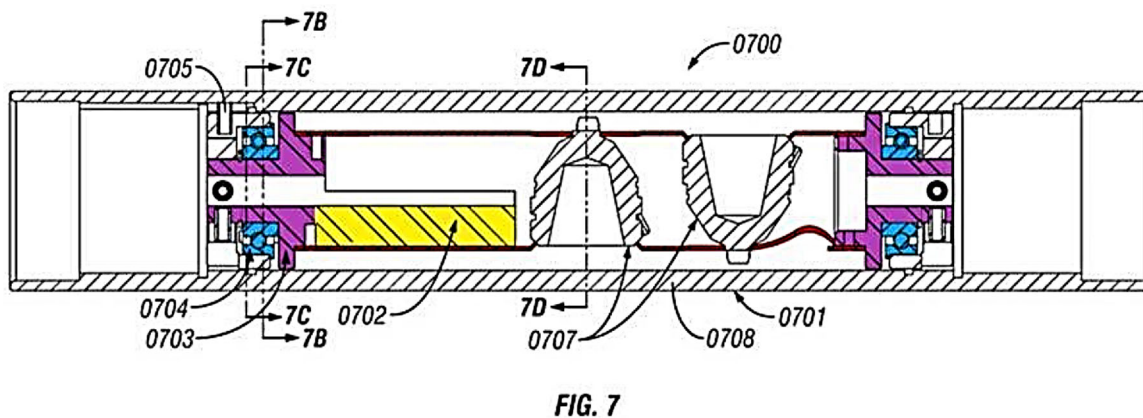
Figure 8 is reproduced below.



Hardesty Figure 8 is a perspective view of perforating gun 1 with internal bearing race system 4 that rotates within a limited arc due to restriction pin 31 (not shown in Figure 8). Ex. 1005, 9:21–24, Fig. 7C.

2. Hardesty Discloses a Gun Body, Support Member, and Weight

Petitioner contends that Hardesty discloses a gun body, a support member, and a weight, as recited in the challenged claims, and provides the following color-coded versions of Hardesty Figures 7 and 8 to illustrate its contentions.



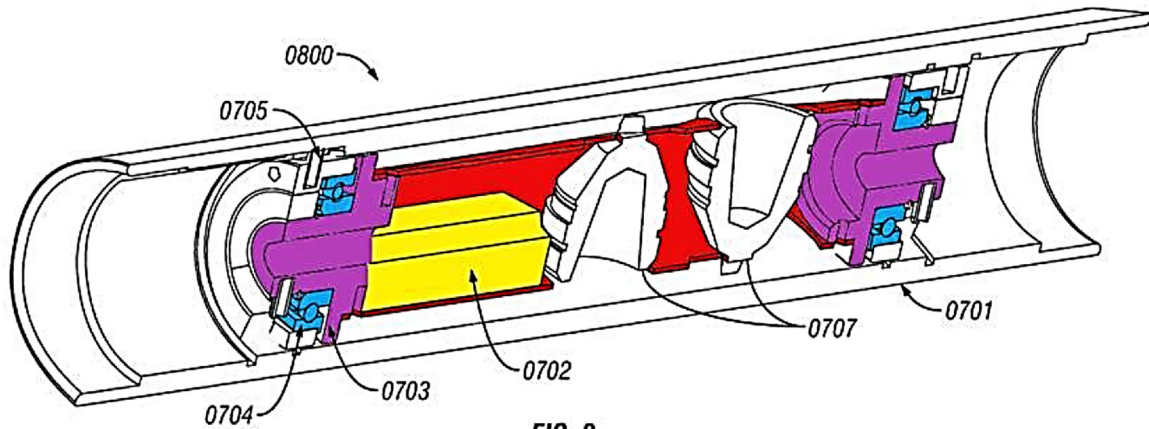


FIG. 8

Pet. 71. Hardesty Figures 7 and 8 show a perforating gun. Petitioner contends that Hardesty's perforating gun includes a gun body (red), a support member (purple), a bearing assembly (blue), and a weight (yellow). Pet. 60–70.

Patent Owner argues that Hardesty does not disclose an independent support member, weight, and gun body. PO Resp. 19–22.

We are persuaded by Petitioner's contention that Hardesty discloses a gun body, a support member, and a weight, as recited in the challenged claims. Referring to color-coded versions of Hardesty Figures 7 and 8, Petitioner contends, and we find:

The “charge holder tube” (0703) would be understood to refer to the red charge holder (gun body) and the purple support members collectively, where each purple support member further would be understood to be a distinct structure from the red charge holder because, e.g., it has boundary lines and opposite cross-hatching from the red charge holder.

Pet. 65 (citing Ex. 1003 ¶¶ 124, 125; Ex. 1005, Figs. 7, 8). Petitioner further contends, and we find:

The weight (yellow) and the left support member (purple) appear to be distinct structural portions of an integral structure. Notably, the weight (0702) is labeled separately from the charge holder

tube (0703), which is made up of the support members (purple) and the gun body (red).

Pet. 70 (citing Ex. 1003 ¶ 129).

The parties and their experts agree that the structure Petitioner identifies as a support member (purple) is part of Hardesty's charge holder tube 3. Pet. 65, 70; PO Resp. 20–21; Ex. 1003 ¶ 124; Ex. 1005, 8:57–65, Figs. 7, 8; Ex. 2001 ¶ 85. The parties and their experts also agree that the structure Petitioner identifies as a support member (purple) is part of an integral structure with Hardesty's weight 2. Pet. 70; PO Resp. 21–22; Ex. 2007 ¶ 129; Ex. 1005, 9:12–14, Figs. 7, 8; Ex. 2007 ¶ 82.

We are nevertheless persuaded by Petitioner's contention that the support member (purple) in Petitioner's color-coded versions of Hardesty Figures 7 and 8 is a “distinct structure” from the rest of Hardesty's charge holder tube 3 that Petitioner identifies as a gun body (red) and a “distinct structural portion[] of an integral structure” that includes weight 2 (yellow). Pet. 65–66, 70–71 (citing Ex. 1003 ¶¶ 124, 125, 129; Ex. 1005, Figs. 7, 8).

Our finding is supported by Hardesty Figures 7 and 8, which show the portion of charge holder tube 3 that Petitioner and Dr. Rodgers identify as a support member (purple) with boundary lines and opposite cross-hatching from the rest of charge holder tube 3, which Petitioner identifies as a gun body (red). Pet. 65–66; Ex. 1003 ¶ 124; Ex. 1005, Figs. 7, 8. Petitioner's interpretation of Hardesty Figure 7 is consistent with the Office's standards for drawings, which provide that “[t]he various parts of a cross section of the same item should be hatched in the same manner” and “[t]he hatching of juxtaposed different elements must be angled in a different way.” 37 C.F.R. § 1.84(h)(3). The boundary lines and opposite cross-hatching in Hardesty

Figures 7 and 8 demonstrate that the purple support member is a distinct structure from the red gun body. Pet. 65–66; Ex. 1003 ¶ 124.

Our finding is further supported by Hardesty’s identification of weight 2 and charge holder tube 3 with different reference numerals. According to Hardesty, Figure 7 shows “a perforating gun (0701) comprising a charge holder tube (CHT) (0703)” and “eccentric weight (0702).” Ex. 1005, 8:57–59, 9:12–14, Figs. 7, 8. Hardesty’s disclosure of separately numbered elements demonstrates that charge holder tube 3 is distinct from weight 2. *See In re: LF Centennial Ltd.*, 654 F. App’x 491, 496 (Fed. Cir. 2016) (finding that “the specification plainly distinguishes between the spine and the side panels” where “[t]he patent figures show the spine as a piece distinct from the side panels, and assign those components different figure numbers.”). Because the structure that Petitioner identifies as a support member (purple) is part of Hardesty’s charge holder tube 3, it too is a distinct from weight 2 (yellow). Pet. 70–71; Ex. 1003 ¶ 129.

Furthermore, Petitioner and Dr. Rodgers identify two separate support members (purple) in Hardesty Figures 7 and 8, and only one of them is shown as being integral with the weight (yellow). Pet. 65–66, 70–71; Ex. 1003 ¶¶ 124, 129; Ex. 1005, Figs. 7, 8. Dr. Rodgers testifies that “each purple support member further would be understood to be a distinct structure from the red charge holder” (Ex. 1003 ¶ 124), and “[t]he weight (yellow) and the left support member (purple) appear to be distinct structural portions of an integral structure” (*id.* ¶ 129). The support member (purple) on the right-hand side of Hardesty Figures 7 and 8 is *not* integral with the weight (yellow) and clearly distinct. Patent Owner does not argue otherwise.

Patent Owner relies on Dr. Wooley’s testimony that “the portion of Figure 7 arbitrarily highlighted in purple by Petitioners is either part of the

charge holder tube or part of the weight. There is simply no disclosure in Hardesty suggesting that this is a separate structural element.” PO Resp. 21; Ex. 2007 ¶ 81. We disagree. Dr. Wooley’s testimony is not supported by Hardesty and outweighed by Petitioner’s evidence as discussed above. Petitioner shows persuasively that Hardesty discloses a support member (purple) that is separate from a gun body (red) and weight (yellow). Pet. 65–66, 70–71; Ex. 1003 ¶¶ 124, 129; Ex. 1005, 8:57–59, 9:12–14, Figs. 7, 8.

3. Remaining Elements and Conclusion

Based upon Petitioner’s undisputed showing, we find that Hardesty discloses all remaining limitations of claims 3, 7, 24–26, 29, 30, and 34–36. Pet. 60–71, 73–74, 77–80; Ex. 1003 ¶¶ 117–130, 135–138, 144–158; *see* PO Resp. 19–22 (arguing that Hardesty does not disclose an independent support member and presenting no other argument addressing Petitioner’s Hardesty anticipation ground).

We conclude that Petitioner has shown by a preponderance of the evidence that claims 3, 7, 24–26, 29, 30, and 34–36 are anticipated by Hardesty.

F. Petitioner’s Yonghong-led Obviousness Challenges

Petitioner challenges claims 4 and 16 as obvious based on Yonghong in view of Schacherer or Eitschberger. Pet. 48–60. Patent Owner opposes. PO Resp. 23–30. We begin our analysis with an overview of Schacherer and Eitschberger.

1. Schacherer (Ex. 1006)

Schacherer discloses a well tool system including multiple explosive assemblies, where each assembly includes an outer housing, at least one

explosive component that rotates relative to the outer housing, and a selective firing module that causes detonation of the explosive component.

Ex. 1006, 1:30–37. Figure 2 is reproduced below.

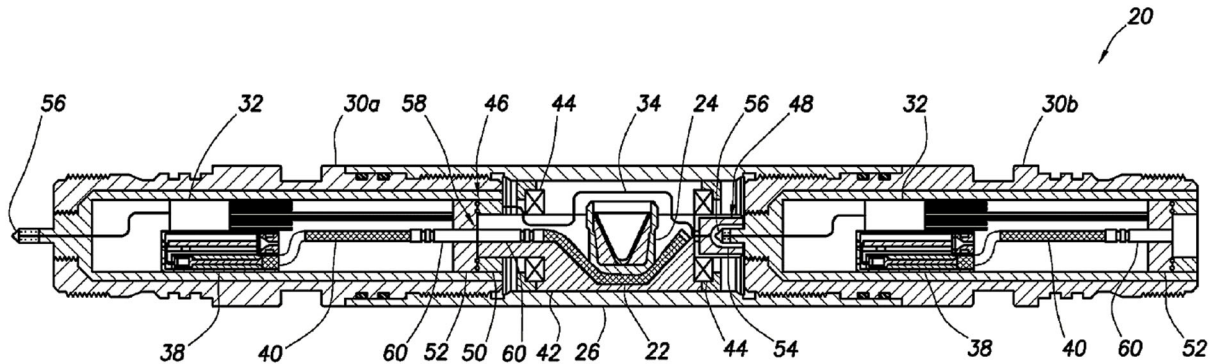


FIG. 2

Schacherer Figure 2 shows explosive assembly 20, including explosive components 22, 24 (also referred to as detonating cord 22 and perforating charges 24, respectively); outer housing 26; connectors 30a, b; selective firing modules 32; electrical conductor 34; electrical detonator 38; explosive components 40 (also referred to as detonating cords 40); eccentric weight 42; bearings 44; rotary electrical connections 46, 48; rotary detonation coupling 58; and boosters 60. Ex. 1006, 2:1–4, 2:35–40, 3:51–4:55. Outer housing 26 is positioned between two threaded connectors 30a, b and houses explosive components 22, 24 and eccentric weight 42, which are supported on bearings 44. *Id.* at 3:60–4:4. Electrical conductor 34 passes through outer housing 26 and is electrically connected to selective firing modules 32 in connectors 30a, b via rotary electrical connections 46, 48, which allow electrical conductor 34 to rotate within the housing. *Id.* at 4:5–10, Fig. 2.

Rotary electrical connection 46 comprises electrical contacts 50, 52; and rotary electrical connection 48 comprises electrical contacts 54, 56.

Ex. 1006, 4:14–39. Electrical contacts 50, 54 are coupled to electrical conductor 34 and rotate along with the explosive components 22, 24 within outer housing 26. *Id.* Electrical contacts 52, 56 are coupled to selective firing modules 32 and are stationary along with the remainder of connectors 30a, b. *Id.*

Detonating cord 22 in outer housing 26 is explosively coupled to detonating cord 40 in connector 30a by rotary detonation coupling 58, which transfers detonation from detonating cord 40 to detonating cord 22 via booster 60 and allows explosive components 22, 24 to rotate relative to outer housing 26, while selective firing module 32 does not rotate. Ex. 1006, 4:40–55.

2. Eitschberger (Ex. 1007)

Eitschberger discloses a bulkhead assembly having a pivotable electric contact component for use with a downhole tool. Ex. 1007, code (57), 1:15–18, 4:10–21. According to Eitschberger, a bulkhead provides an electrical contact or feed-through in string perforating gun assemblies. *Id.* at 2:15–29.

Figure 2 is reproduced below.

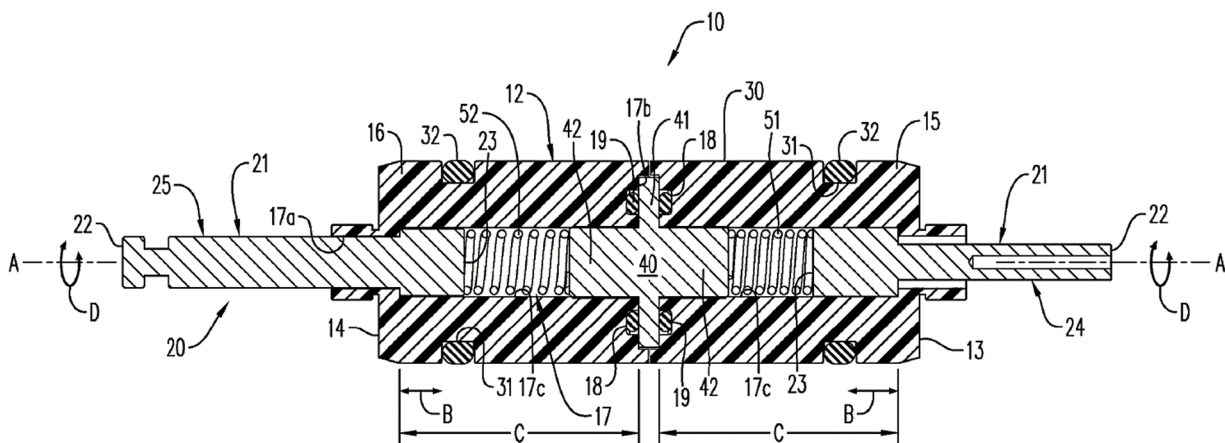


FIG. 2

Eitschberger Figure 2 shows bulkhead assembly 10 including bulkhead body 12 made of thermoplastic or other electrically non-conductive material and electrically conductive electrical contact component 20, which pivotably extends through bore 17 of bulkhead body 12 and provides feed-through of an electric signal. Ex. 1007, 3:32–33, 4:30–50, 5:25–34. As shown in Figure 2, bulkhead assembly 10 includes first contact pin 24 extending from first end portion 13 of bulkhead body 12 and second contact pin 25 extending from second end portion 14. *Id.* at 4:38–41, 6:1–8.

Figure 5 is reproduced below.

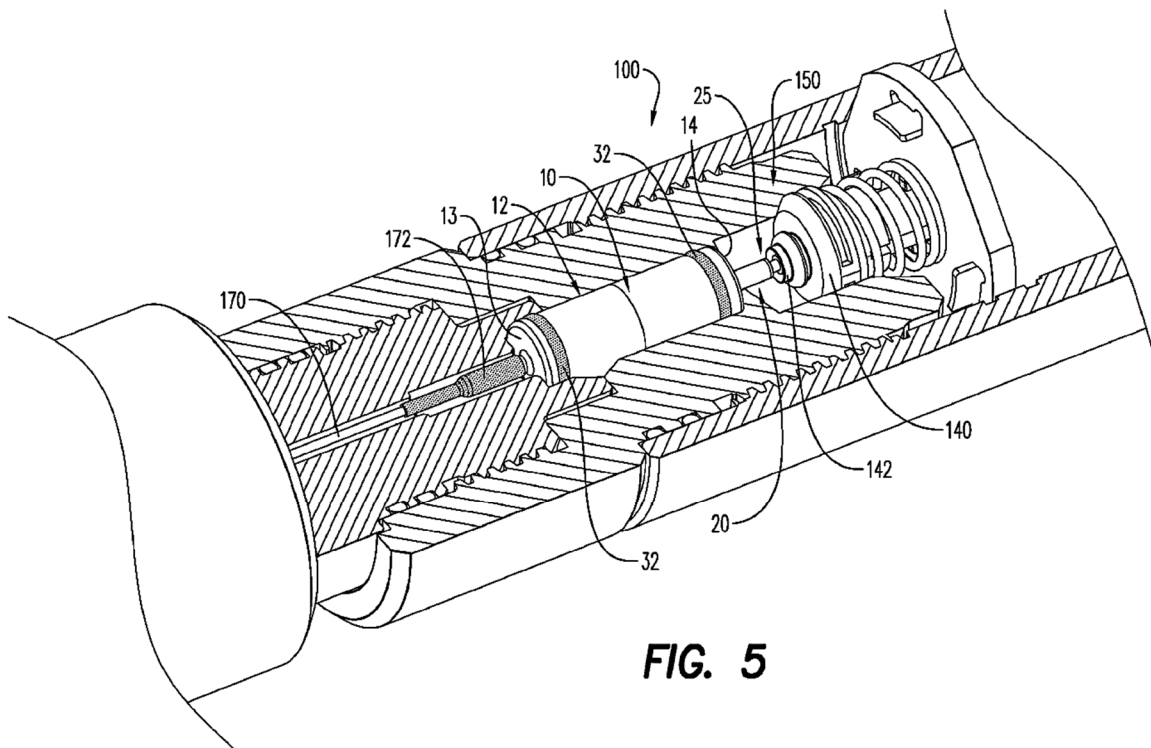


FIG. 5

Eitschberger Figure 5 shows downhole tool or perforating gun assembly 100 including tandem seal adapter or tandem sub 150, bulkhead assembly 10, and electrical contact component 20. Ex. 1007, 7:30–57. First contact pin 24 (not shown in Figure 5) is covered by insulator 172 and connects to wired electrical connection 170, and second contact pin 25 wirelessly

electrically contacts electrical contacting component 142 of initiator (detonator or igniter) 140. *Id.* at 7:50–8:6.¹¹

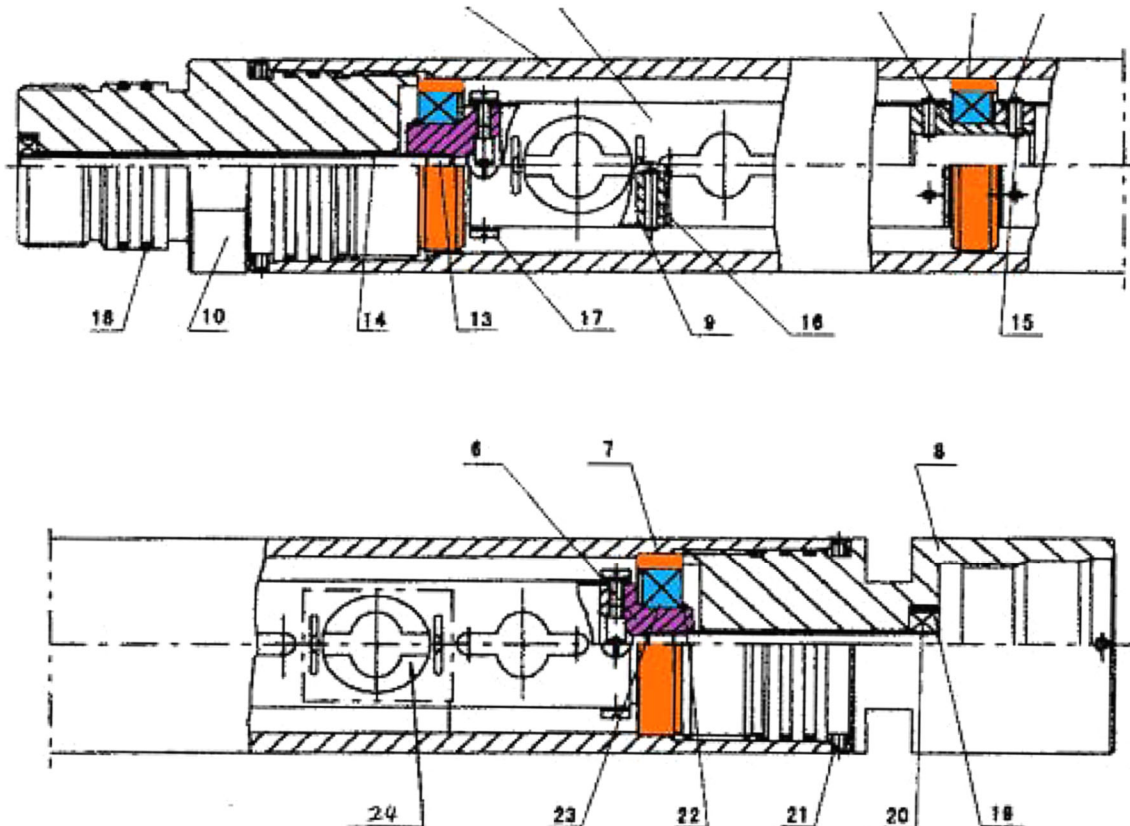
3. *Claim 4*

Claim 4 depends from disclaimed claim 1 and recites that the gun system further comprises “an end contact configured to transmit the electricity to the gun system, wherein the end contact is at least partially disposed through the collar and the bearing assembly.”

a) *Yonghong and Schacherer*

Petitioner acknowledges that Yonghong does not disclose the limitation of claim 4. Pet. 54. Petitioner contends that it would have been “obvious to incorporate Schacherer’s rotary electrical and detonation connections into Yonghong’s gun system to provide a reliable through wire connection for a select-fire gun system.” *Id.* Referring to the color-coded version of Yonghong Figure 1 reproduced below, Petitioner contends that it would have been “obvious to incorporate into the ‘support member’ (purple) . . . Schacherer’s electrical connector, through the collar (orange) and bearing assembly (blue).” Pet. 54–55.

¹¹ Eitschberger explains that “the term ‘wireless’ does not refer to a WiFi connection, but rather to th[e] notion of being able to transmit electrical signals through the electrical componentry without connecting external wires to the component.” Ex. 1007, 10:67–11:4.



Pet. 56. Yonghong Figure 1 shows a gun body of a perforating gun.

Petitioner contends that it would have been “obvious to substitute Yonghong’s ‘connector’—i.e., tandem sub—with Schacherer’s connector, including selective firing module and electrical connector coupling the selective firing module to an electrical feedthrough, to provide an electrical feedthrough system in Yonghong.” Pet. 55. Petitioner further contends that it would have been “obvious to couple Yonghong’s rotating detonating cord to Schacherer’s detonation coupling.” *Id.*

Addressing reasons to combine, Petitioner asserts that “incorporating Schacherer’s rotary electrical and ballistic connections would maintain Yonghong’s principle of rotating detonating cords while providing select-fire operation and would simplify Yonghong by replacing the detonating cord protecting tube and necessary assembly with a rotary detonation

coupling.” Pet. 49–50. Petitioner asserts, “[t]his combination of Yonghong and Schacherer would be a straightforward substitution of Schacherer’s rotary electrical and ballistic connections for Yonghong’s detonating cord protecting tube and would obtain predictable results.” Pet. 50 (citing Ex. 1003 ¶ 103).

Patent Owner argues that Yonghong’s detonating cord protection tube is a “fundamental component” that cannot be eliminated without “substantial reconstruction and redesign” and changing Yonghong’s basic principles of operation. PO Resp. 24 (citing Ex. 2001 ¶ 72). Patent Owner contests the sufficiency of Petitioner’s rationale for combining Yonghong and Schacherer, arguing that the first benefit alleged by Petitioner—providing select-fire operation—has nothing to do with Petitioner’s proposed modification of Yonghong—incorporating a rotary connection as disclosed in Schacherer. PO Resp. 25 (citing Ex. 2001 ¶ 70). Patent Owner argues that Petitioner’s proposed modification would complicate, rather than simplify, the system disclosed in Yonghong. *Id.* (citing Ex. 2001 ¶ 71).

In the Institution Decision, we did not find a reasonable likelihood that Petitioner would prevail on its challenge to claim 4 based on Yonghong and Schacherer. Inst. Dec. 26–28. We were not persuaded that Petitioner showed that a desire for select-fire operation would have led a POSITA to combine Yonghong and Schacherer in a way that meets the limitation of claim 4. *Id.*

On the record now before us, we remain unpersuaded by Petitioner’s arguments and evidence. “Obviousness requires, *inter alia*, a finding that a skilled artisan would have been motivated to combine the teachings of prior art *in such a way that the combination discloses the claimed limitations.*” *Elekta Ltd. v. ZAP Surgical Sys., Inc.*, 81 F.4th 1368, 1374 (Fed. Cir. 2023)

(emphasis added). Petitioner asserts that a POSITA would have been motivated to provide select-fire operation in Yonghong by incorporating Schacherer's rotary electrical and ballistic connections (Pet. 49–50, 54–55) but does not explain how that motivation would have led a POSITA to the configuration in claim 4 without relying on impermissible hindsight. Claim 4 recites “an end contact configured to transmit the electricity to the gun system, wherein the end contact is at least partially disposed through the collar and the bearing assembly.” Petitioner does not show how a desire for select-fire operation would have led a POSITA to combine Yonghong and Schacherer in a way that includes an end contact that is at least partially disposed through the collar and the bearing assembly.

Petitioner argues that “a POSITA would be motivated to provide select-fire operation in Yonghong—especially without modifying the basic assembly or principles of Yonghong.” Pet. 50. But Petitioner does not explain why a POSITA who wanted select-fire operation would have relied on Yonghong. Stated differently, Petitioner does not identify teachings from Yonghong that would have been valuable to a POSITA whose goal was to provide select-fire operation or teachings that a POSITA would have wanted to combine with Schacherer. In the absence of persuasive reasoning, we find that Petitioner's selection of Yonghong as the starting point for its obviousness combination is based on impermissible hindsight.

Yonghong describes a perforating gun having a rotating charge tube assembly that uses an eccentric weight to orient the charges in a horizontal well bore. Ex. 1004, Abstract; *see also* Pet. 17 (Petitioner's summary of Yonghong). Schacherer includes these same teachings in a perforating gun that provides select-fire operation. Ex. 1006, 1:28–37, 2:30–56; *see also* Pet. 21 (Petitioner's summary of Schacherer). Although Petitioner asserts

that select-fire operation would have been “a desirable improvement for known, internally orienting perforating guns such as Yonghong discloses” (Pet. 50), Petitioner does not identify any persuasive reason for basing its obviousness analysis on Yonghong, when Schacherer already provides select-fire operation in an internally orienting perforating gun. Again, Petitioner’s selection of Yonghong appears to be based on impermissible hindsight.

Petitioner asserts that “a POSITA would be motivated to combine Schacherer with Yonghong because incorporating Schacherer’s rotary electrical and ballistic connections would maintain Yonghong’s principle of rotating detonating cords while providing select-fire operation.” Pet. 49. Yonghong’s principle of rotating detonating cords is not a persuasive reason to begin the obviousness analysis with Yonghong because Schacherer already teaches a rotating detonation cord. Ex. 1007, 2:30–37, 3:66–4:2, 4:7–10, Fig. 2 (detonating cord 22 and perforating charges 24 are rotatable within outer housing 26).

Petitioner asserts that a POSITA would have been motivated to modify Yonghong in view of Schacherer to provide for select-fire operation, but does not show persuasively how or why that combination would have led a POSITA to claim 4, which recites “an end contact configured to transmit the electricity to the gun system, wherein the end contact is at least partially disposed through the collar and the bearing assembly.” The Petition provides no persuasive reason or motivation for a POSITA to adopt the end contact configuration recited in claim 4.

Petitioner asserts that its combination would maintain Yonghong’s principle of rotating detonating cords and substitute Schacherer’s rotary electrical and ballistic connections for Yonghong’s detonating cord

protection tube. Pet. 49–50. On this record, it is unclear how Petitioner’s combination would have satisfied claim 4, while at the same time providing select-fire operation and maintaining Yonghong’s principle of rotating detonating cords, as asserted by Petitioner and Dr. Rodgers. Pet. 49, 54; Ex. 1003 ¶¶ 103, 110.

Schacherer discloses outer housing 26 containing rotating explosive components, rotary electrical connection 48 at one end of the outer housing, and both rotary electrical connection 46 and rotary detonation coupling 58 at the other end of the outer housing. Ex. 1006, 4:5–7, 4:14–20, 4:27–33, 4:40–45, 4:49–55, Fig. 2. As discussed in the Institution Decision and not disputed by Petitioner, only one of Schacherer’s rotary electrical connections—48—meets the limitation of claim 4, and rotary electrical connection 48 does not accommodate a rotary detonation coupling at the same end of the gun. Inst. Dec. 27–28 (citing Pet. 22; Ex. 1003 ¶ 46; Ex. 1006, Fig. 2).

Yonghong, on the other hand, discloses a rotating detonating cord and a detonating cord protection tube extending from both ends of a charge tube so that the detonating cord can transfer a ballistic signal to adjacent guns. Pet. 49; Ex. 1003 ¶ 39; Ex. 1004, 6, 8 (“the detonating cord penetrates through inner holes of the charge tube shaft at both ends of the charge tube”), Fig. 1. Yonghong’s rotating detonating cord extends along the central axis of charge tube shaft 6, bearing 23, and bushing 4 in the same position as claim 4 specifies for an electrical end contact, i.e., “at least partially disposed through the collar and the bearing assembly.” Ex. 1004, Fig. 1.

Petitioner proposes to modify Yonghong by incorporating Schacherer’s rotary electrical and ballistic connections, for example, by

substituting Schacherer's connector for Yonghong's connector and coupling Yonghong's rotating detonating cord to Schacherer's detonation coupling. Pet. 49–50, 54–55. Petitioner relies on Dr. Rodgers' testimony that a "POSITA would have found it obvious to incorporate Schacherer's rotary electrical 48 and detonation 58 connections into Yonghong's gun system to provide a reliable through wire connection for a select-fire gun system." Ex. 1003 ¶ 110 (cited at Pet. 56).

As discussed above, Yonghong's rotating detonating cord extends from both ends of the gun body so as to connect with adjacent guns, whereas Schacherer's rotary electrical connection 48 and rotary detonation coupling 58 are at opposite ends of a gun body. Ex. 1004, Fig. 1; Ex. 1006, Fig. 2. Petitioner argues that a POSITA would have maintained Yonghong's rotating detonating cord and coupled it to a rotary detonation coupling. Pet. 49–50, 54–55; Ex. 1003 ¶¶ 39, 110.

Petitioner does not persuade us that it would have been obvious to modify Yonghong to include an end contact that satisfies claim 4 while maintaining Yonghong's rotating detonating cord. Petitioner does not explain how a POSITA would have made electrical connections at both ends of the gun, as required for select-fire operation, and still maintain Yonghong's detonating cord, which extends from both ends of the gun in the same position relative to the collar and bearing assembly as claim 4 specifies for an electrical end contact. Petitioner was not required to show physical combinability, but was required to prove that it would have been obvious to modify Yonghong to include the end contact arrangement of claim 4. The Petition presents no obviousness theory that does not rely on maintaining Yonghong's rotating detonating cord. Petitioner does not show persuasively that a POSITA would have modified Yonghong to incorporate the end

contact arrangement of claim 4 while maintaining its rotating detonating cord and coupling it to a rotary detonation coupling. The Board must evaluate Petitioner's arguments as presented in the Petition, not arguments that "could have been included in a properly-drafted petition." *Magnum Oil*, 829 F.3d at 1380; *see also Sirona Dental Sys. GmbH v. Institut Straumann AG*, 892 F.3d 1349, 1356 (Fed. Cir. 2018) ("It would thus not be proper for the Board to deviate from the grounds in the petition and raise its own obviousness theory."). Petitioner cannot prevail, even if claim 4 may have been obvious based on a theory not presented in the Petition.

Petitioner also does not prove that replacing Yonghong's detonating cord protection tube with a rotary detonation coupling would have simplified Yonghong's design. Pet. 49–50. We are persuaded by Dr. Wooley's testimony that Petitioner's proposed modification would have complicated, rather than simplified, the system disclosed in Yonghong. Ex. 2001 ¶ 71; Ex. 2007 ¶ 60. Although Petitioner characterizes the modification as a simple substitution of one connector (or tandem sub) for another (Pet. 55; Pet. Reply 13, 16), Dr. Rodgers' testimony demonstrates it would have been more complicated. Ex. 1003 ¶ 110. For example, Schacherer's electrical contact 54, alleged to be the "end contact" of claim 4 (*id.* ¶¶ 46, 110), is not part of Schacherer's connector. Ex. 1006, 4:27–31 (electrical contact 54 rotates with the explosive components while "electrical contact 56 is stationary, along with the remainder of the connector 30*b*"), Fig. 2.

For these reasons, we are not persuaded by Petitioner's argument that "a POSITA would be motivated to combine Schacherer with Yonghong because incorporating Schacherer's rotary electrical and ballistic connections would maintain Yonghong's principle of rotating detonating cords while providing select-fire operation and would simplify Yonghong by

replacing the detonating cord protecting tube and necessary assembly with a rotary detonation coupling.” Pet. 49–50. Petitioner’s failure to prove that the asserted motivations would have led to the arrangement of claim 4 indicates that its obviousness contention is based on impermissible hindsight, rather than a POSITA’s desire for select-fire operation and simplification of Yonghong.

Petitioner’s Reply introduces several new obviousness theories that were not presented in the Petition, exceed the proper scope of a reply, and undermine the Petition. 37 C.F.R. § 42.23(b); *Rembrandt Diagnostics, LP v. Alere, Inc.*, 76 F.4th 1376, 1383 (Fed. Cir. 2023) (“[T]he Board acts within its discretion when declining to consider a new theory of unpatentability raised by petitioner in reply.”). We address Petitioner’s reply arguments below and find that each of them presents in impermissible new theory of unpatentability. Although those findings are sufficient to dispose of Petitioner’s reply arguments, we also address the merits of Petitioner’s new theories.

First, Petitioner argues for the first time in the Reply that claim 4 is the only possible arrangement for an end contact and the only way to incorporate an end contact in Yonghong. Pet. Reply 12 (“Claim 4 requires only that the end contact be at least partially disposed through the collar and bearing assembly, because the end contact **must** pass through those annularly arranged components ‘to transmit the electricity to the gun system.’” (citing Ex. 1019 ¶ 17)); *id.* at 14 (“A POSITA would understand that incorporating an end contact in Yonghong would require positioning it at least partially through the bushing 4 and bearing 23.” (citing Ex. 1019 ¶ 25)). Petitioner’s reply argument relies on new evidence in the form of opinions of Dr. Rodgers. Ex. 1019 ¶¶ 17, 25. This theory of unpatentability

was not presented in the Petition, which as discussed above, failed to provide any reason or motivation for a POSITA to adopt the end contact arrangement of claim 4. Petitioner's reply argument is meaningfully distinct from the Petition's theory of unpatentability, which focused on select-fire operation and simplification as reasons for modifying Yonghong (Pet. 48–54) and did not explain how those motivations would have led a POSITA to the end contact arrangement of claim 4. *See Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1367 (Fed. Cir. 2015) (The Board did not err by rejecting petitioner's reliance in its reply submission on “previously unidentified portions of a prior-art reference to make a meaningfully distinct contention.”).

Petitioner's new theory is not persuasive in any event. Petitioner's assertion that claim 4 is the only possible arrangement for an end contact is belied by Schacherer's rotary electrical connection 46, which does not satisfy claim 4. Petitioner annotates Schacherer Figure 2 to identify a collar (orange) and bearings (blue) (Pet. 22–23), but makes no assertion that rotary electrical connection 46 includes an end contact that is “at least partially disposed through the collar and the bearing assembly,” as recited in claim 4. Eitschberger provides another example of an end contact that does not meet claim 4. Petitioner identifies Eitschberger's electrical contacting component 142 as an end contact (Pet. 25, 51–52; Ex. 1003 ¶¶ 49, 107), but does not assert that Eitschberger discloses a collar or bearing assembly. Although Petitioner asserts that concentric electrical connections are “ubiquitous” in downhole tools (Pet. Reply 2), Petitioner makes no attempt to show that all or even some of these connections include an end contact arrangement as recited in claim 4.

Second, Petitioner argues for the first time in the Reply that a “POSITA would understand that incorporating the end contact in Yonghong through inner holes of the charge tube shaft 6 would not add costs or length to the assembly.” Pet. Reply 14 (citing Ex. 1018, 108:8–19; Ex. 1019 ¶ 24). Petitioner’s reliance on cost and length as a reason to for combining Yonghong and Schacherer is a new argument that is meaningfully distinct from the Petition’s reasoning. The Petition relies on a desire for select-fire operation and simplification of Yonghong (Pet. 49–50) and makes no mention of cost or length as a reason for combining the references. Petitioner’s new argument is not persuasive in any event because Petitioner does not explain how or why cost or length considerations would have led a POSITA to the end contact arrangement in claim 4.

Third, Petitioner argues for the first time in the Reply that “Yonghong instructs a POSITA where and how to place feedthrough connections—whether ballistic or electrical . . .—through the bearing assembly and collar.” Pet. Reply 15 (citing Ex. 1018, 151:6–19; Ex. 1019 ¶ 25); *see also id.* at 12 (similar argument citing Ex. 1019 ¶ 17). This theory of unpatentability was not presented in the Petition, which conceded that Yonghong does not disclose the end contact limitation of claim 4. Pet. 54. The Petition relies on Schacherer or Eitschberger, not Yonghong, to support its contention about where and how to place an electrical contact in Yonghong. Pet. 54–57. Petitioner’s reply argument is meaningfully distinct from the Petition and procedurally improper. *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1329–31 (Fed. Cir. 2019) (The Board did not abuse its discretion by rejecting a new theory of unpatentability where petitioner argued for the first time in its Reply that a reference disclosed a limitation.).

Petitioner's new argument is not persuasive in any event. Petitioner asserts that "Yonghong expressly describes making the feedthrough connection along the longitudinal axis of the gun tube 1, through the annular bearing 23 and bushing 4 according to claim 4." Pet. Reply 15 (citing Ex. 1004, 8; Ex. 1019 ¶¶ 24, 25). As support, Dr. Rodgers selectively quotes from the following disclosure in Yonghong:

The operating principle thereof is: after the detonating cord penetrates *through inner holes of the charge tube shaft* at both ends of the charge tube, first the backstop tube (13) is used to close the hole, and then one end of the detonating cord protection tube (14) is connected to the charge tube shaft, and the other end penetrates through the small bearings (20) and the retaining ring (19) mounted in the upper and lower connectors, after which it is intermediately abutted with one end of the detonating cord protection tube (14) at the other end; the abutment gap is in a range of 2–3 mm.

Ex. 1004, 8–9 (italicized text quoted at Ex. 1019 ¶ 25). As described in the above passage and illustrated in Figure 1, Yonghong discloses a detonating cord that passes through a central hole in a charge tube shaft. *Id.* at 8–9, Fig. 1. As Petitioner and Dr. Rodgers admit, Yonghong does not teach an electrical contact, nor the location of an electrical contact relative to a collar or bearing assembly. Pet. 54; Ex. 1003 ¶ 109.

Yonghong also does not teach any sort of connection, whether electrical or ballistic, with an end contact "at least partially disposed through the collar and the bearing assembly," as recited in claim 4. Instead, Yonghong teaches that two detonating cords abut one another in the vicinity of small bearings 20 and retaining ring 19. Ex. 1004, 8–9, Fig. 1; *see also* Ex. 1003 ¶ 39 (explaining that ballistic signal transfer between detonating cords occurs "within the connector (8, 10)"). In other words, Yonghong teaches a ballistic connection in a location *remote* from bushing 4 and

bearing 23, which correspond to the collar and bearing assembly in claim 4. *Id.* The reference does not support Petitioner's assertion that "Yonghong expressly describes making the feedthrough connection . . . through the annular bearing 23 and bushing 4." Pet. Reply 15. It also does not support Dr. Rodgers' testimony that Yonghong discloses "positioning the end contact at least partially through the bushing 4 and bearing 23." Ex. 1019 ¶ 25. Petitioner and Dr. Rodgers misinterpret the teachings of Yonghong using impermissible hindsight in an unsuccessful attempt to reach claim 4.

Lastly, Petitioner argues for the first time in the Reply that "[t]he *only* modification required to Yonghong is the routine incorporation of the end contact within the annular assembly" and "[w]hether a POSITA incorporates Schacherer's rotary ballistic connection 58 is inapposite." Pet. Reply 16–17 (citing Ex. 1019 ¶¶ 25, 26). In contrast, the Petition proposes to modify Yonghong by incorporating Schacherer's rotary electrical *and* ballistic connections. Pet. 49–50, 54–55. Petitioner's change of position was clearly demonstrated at the hearing. When asked to confirm that "[P]etitioner's proposed modification of Yonghong is to incorporate both the rotary ballistic and rotary electrical connections from Schacherer into Yonghong," Petitioner responded, "No. Just the rotary electric connection."

Tr. 11:23–12:1. According to Petitioner, "[t]he detonation cord and the protection tube are no longer needed in a modified system, because once you move to select firing, . . . you don't need the rotary ballistic connection"

Id. at 12:10–20. Petitioner argued that the Petition proposed "to incorporate the rotary electric *and/or* the ballistic connection." Tr. 12:3–4, 12:15–17.

Petitioner's argument plainly misstates the Petition, which repeatedly asserts it would have been obvious to modify Yonghong by incorporating Schacherer's rotary electrical *and* ballistic connections and coupling

Yonghong’s rotating detonating cord to Schacherer’s detonation coupling. Pet. 49–50, 54–55. Petitioner’s new theory is not persuasive in any event. Petitioner concedes that modifying Yonghong by adding an end contact without a ballistic connection would not have been a workable model. Tr. 15:26–16:9.

Petitioner’s attempt to rewrite the Petition undermines its credibility and reinforces our finding that Petitioner’s reasoning is biased by hindsight. Petitioner’s argument that a POSITA would have modified Yonghong only to the extent necessary to reach the claimed configuration is impermissible hindsight reconstruction. Tr. 12:5–6 (Petitioner: “The rotary ballistic connection is something that could be incorporated by the POSITA but wasn’t necessary to reach the claimed configuration.”); *id.* at 13:7–12, 13:21–24 (similar argument).

In sum, evaluating Petitioner’s evidence and arguments as a whole, we determine that Petitioner has not presented a credible, non-hindsight biased theory of obviousness for claim 4 based on Yonghong and Schacherer that is sufficient to meet its burden of proof.

b) Yonghong and Eitschberger

Petitioner contends that it would have been “obvious to incorporate the electrical contacting component of Eitschberger into Yonghong’s system” so as “to connect to a detonator and/or electrical feedthrough within the charge tube.” Pet. 56–57 (citing Ex. 1003 ¶ 112 n.3).¹² Petitioner asserts:

¹² Petitioner begins its argument about Eitschberger with the phrase, “[i]n addition, or in the alternative.” Pet. 56. Because Petitioner does not present argument or evidence to support a three-reference combination, we limit our

A POSITA would also understand that Yonghong describes tandem subs (“connectors”) within which, according to Eitschberger, a bulkhead including contact pins could be received in a bore to electrically connect to the electrical contacting component, for transferring a signal to a select-fire detonator within the charge tube, as part of the electrical feedthrough for the select-fire operation of Yonghong’s system in view of Eitschberger. In addition, Eitschberger’s single centerline pin contact provides the benefit of a low-friction electrical connection allowing free rotation of the charge tube in the gravity-oriented system.

Pet. 57–58 (citing Ex. 1003 ¶ 112).

Addressing reasons to combine, Petitioner contends that a POSITA would have been motivated “to incorporate the select-fire electrical feedthrough assembly of Eitschberger, to provide select-fire operation in Yonghong while maintaining the basic configuration of components” and that “substitution of Eitschberger’s select-fire electrical feedthrough assembly for Yonghong’s detonating cord protecting tube” would have been “straightforward” and “predictable.” Pet. 51 (citing Ex. 1003 ¶ 106).

Petitioner contends that Eitschberger discloses an electrical contacting assembly extending through a central hole in an end cap coupled to an end of a charge tube (Pet. 51 (citing Ex. 1003 ¶ 107; Ex. 1007, 7:64–8:6, Fig. 5)) and, in Yonghong, “an electrical contacting assembly could likewise extend through an inner hole of the respective charge tube shafts,” which are coupled to a charge tube (Pet. 52–53 (citing Ex. 1003 ¶ 107; Ex. 1004, 6, Fig. 1)).

discussion to Petitioner’s two-reference combinations, Yonghong and Schacherer or Yonghong and Eitschberger.

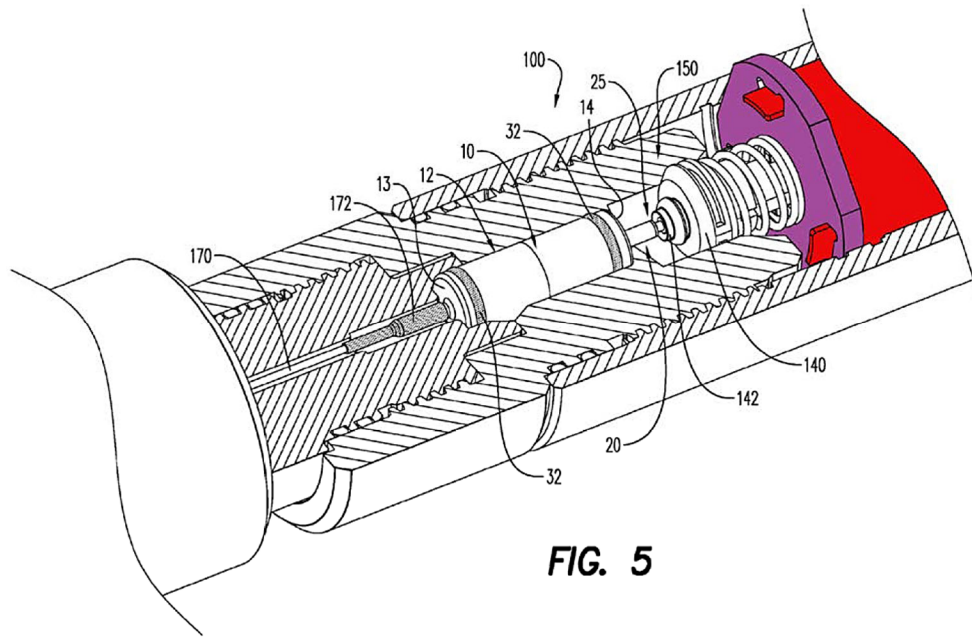
Patent Owner contests the sufficiency of Petitioner’s rationale for combining Yonghong and Eitschberger, arguing that Petitioner’s proposed modification of Yonghong “ultimately has nothing to do with allowing for a select-fire configuration”—Petitioner’s alleged motivation for combining Yonghong and Eitschberger. PO Resp. 26–27 (citing Ex. 2001 ¶ 73). Patent Owner argues that Petitioner’s proposed modification would complicate, rather than simplify, the mechanism of Yonghong. *Id.* at 27–28 (citing Ex. 2001 ¶ 74). In addition, Patent Owner argues that Eitschberger does not teach the limitation of claim 4. *Id.* at 28–29 (citing Ex. 2007 ¶ 65). Patent Owner counters Petitioner’s alleged motivation by arguing “[o]ne of ordinary skill in the art concerned with safety and reliability of detonation propagation would not have been motivated to modify Yonghong by removing the ‘safe detonation propagation structure’ and replacing it with something else.” *Id.* at 29 (citing Ex. 2007 ¶ 66).

In the Institution Decision, we did not find a reasonable likelihood that Petitioner would prevail on its challenge to claim 4 based on Yonghong and Eitschberger. Inst. Dec. 30–32. We were not persuaded that Petitioner showed that a desire for select-fire operation would have led a POSITA to combine Yonghong and Eitschberger in a way that meets the limitation of claim 4. *Id.*

On the record now before us, we remain unpersuaded by Petitioner’s arguments and evidence. Petitioner asserts that a POSITA would have been motivated to provide select-fire operation in Yonghong by incorporating the electrical feedthrough assembly of Eitschberger (Pet. 50–54, 56–58) but does not explain how that motivation would have led a POSITA to the configuration in claim 4 without relying on impermissible hindsight.

Petitioner acknowledges that Yonghong does not disclose the limitation of claim 4 (Pet. 54) and does not show that Eitschberger discloses an end contact “at least partially disposed through the collar and the bearing assembly,” as recited in claim 4. The Petition does not identify any collar or bearing assembly in Eitschberger and does not allege that Eitschberger discloses the end contact arrangement of claim 4. Although Petitioner asserted at the hearing that Petitioner does contend that Eitschberger discloses the limitation of claim 4 and directed us to pages 50–54 and 56–57 of the Petition (Tr. 20:18–24), we see no contention there that Eitschberger discloses a collar or bearing assembly, nor any proof that Eitschberger’s end contact (electrical contacting component 142) is at least partially disposed through a collar and bearing assembly, as recited in claim 4. *See* Ex. 2007 ¶ 65 (Dr. Wooley’s testimony agreeing with our findings in the Institution Decision about claim 4 and Eitschberger).

Petitioner does not provide a persuasive reason or motivation for combining Yonghong and Eitschberger in a way that satisfies claim 4. Referring to the color-coded figure reproduced below, Petitioner contends would have been “obvious to position the electrical contacting component of Eitschberger within the opening through the support member (purple) (also through the collar (orange) and bearing assembly (blue)) at the end of the charge tube (red) of Yonghong, to connect to a detonator and/or electrical feedthrough within the charge tube.” Pet. 56–57 (citing Ex. 1003 ¶ 112, n.3).



Pet. 52; Ex. 1003 ¶ 107. Eitschberger Figure 5 shows a perforating gun assembly. Referring to the above figure, Dr. Rodgers asserts that Eitschberger discloses “an electrical contacting assembly (142, 140) extend[ing] through a central hole in [an] end cap (purple)” which is “coupled to an end of [a] charge tube (red).” Ex. 1003 ¶ 107 (citing Ex. 1007, 7:64–8:6; cited at Pet. 51). Dr. Rodgers’ assertion is not supported by Eitschberger, which does not disclose that either initiator 140 or electrical contacting component 142 extends through an end cap of a charge tube. Furthermore, the evidence does not support positioning a detonator within a charge tube, as proposed by Petitioner and Dr. Rodgers. Pet. 57; Ex. 1003 ¶ 112.

The foregoing analysis is essentially the same as set forth in the Institution Decision. Inst. Dec. 26–28. In the Reply, Petitioner responds to our findings by arguing that, in Eitschberger, the “end contact” incorporates electrical contact 142 positioned on a spring-loaded assembly connected to initiator or detonator 140, which Petitioner asserts is not shown in Figure 5

because it is “‘held in an inner tube’ (in red).” Pet. Reply 19 (citing Ex. 1019 ¶ 31; Ex. 1007, 1:49–56, 2:26–29, 7:61–8:4). According to Petitioner, “Eitschberger discloses an end contact (i.e., spring loaded electrical contact) disposed at least partially through a hole within an end cap (purple), for transmitting an electrical signal to the perforating gun system.” *Id.* (citing Ex. 1019 ¶ 31).

Eitschberger does not support Petitioner’s reply arguments. Eitschberger describes a perforating gun assembly as including “one or more charges which are held in an inner tube” (Ex. 1007, 1:49–56), but does not disclose that an initiator or detonator is held within an inner tube, as asserted by Petitioner and Dr. Rodgers. Pet. Reply 19; Ex. 1019 ¶ 31. Furthermore, although Eitschberger states that initiator 140 is “not shown” in Figure 5 (Ex. 1007, 7:61–64), the figure actually shows initiator 140 located outside of the red structure Petitioner identifies as an “inner tube.” *Id.* at Fig. 7; Pet. 51–52; Pet. Reply 18–19; Ex. 1003 ¶ 107. Moreover, the Petition and Dr. Rodgers’ initial declaration rely on Eitschberger’s detonator electrical contacting component 142 (Ex. 1007, 7:64–8:4, Fig. 5) as the “end contact” of claim 4. Pet. 56; Ex. 1007 ¶ 112; Pet. Reply 18. Eitschberger Figure 5 does not support Petitioner’s reply argument that Eitschberger’s end contact (i.e., detonator electrical contacting component 142) is “disposed at least partially through a hole within an end cap (purple).” Pet. Reply 19 (citing Ex. 1019 ¶ 31).

Petitioner does not show persuasively that a POSITA would have added an end contact to Yonghong in the manner shown in Petitioner’s modification of Yonghong Figure 1. Pet. 57; *see* page 45, *supra*. Petitioner and Dr. Rodgers engage in classic hindsight reconstruction using claim 4 as a roadmap for arranging the prior art components. Pet. 57; Ex. 1003 ¶ 112.

The reverse orientation of Eitschberger's bulkhead assembly 10 as compared with Eitschberger Figure 5 evidences hindsight reconstruction. *See* page 45 n.13, *supra*. Additional evidence of hindsight is provided by Petitioner's alteration of the relative positions of Eitschberger's initiator 140, electrical contacting component 142, spring (unnumbered), and what Petitioner and Dr. Rodgers call an "end cap (purple)." Pet. 51; Ex. 1003 ¶ 107.

Eitschberger Figure 5 shows initiator 140, electrical contacting component 142, and spring (unnumbered) completely outside of the alleged end cap, with the spring "positioned between and against the end cap (purple) and an electrical contact of an initiator." Pet. 51; Ex. 1003 ¶ 107; Ex. 1007, Fig. 5. In contrast, Petitioner's modification of Yonghong Figure 1 shows a spring completely within a central bore in charge tube shaft 6, which Petitioner colors purple to show correspondence with Eitschberger's "end cap." Pet. 57; Ex. 1003 ¶ 112. Yonghong and Eitschberger do not support Petitioner's modified figure, which is biased by hindsight.

In the Reply, Petitioner argues that Yonghong and Eitschberger both disclose "a tandem sub having external threads and o-ring seals for connecting to a perforating gun outer casing" and a "POSITA would therefore understand to simply substitute Eitschberger's tandem sub 150 for Yonghong's connector 10." Pet. Reply 13, 19 (citing Ex. 1019 ¶¶ 19, 34). Petitioner's reply argument is belied by Petitioner's proposed combination of Yonghong and Eitschberger as set forth in the Petition. Pet. 57.

Petitioner modifies Yonghong Figure 1 to include bulkhead assembly 10 of Eitschberger Figure 2, initiator (detonator or igniter) 140 from Eitschberger Figure 5, a detonating cord, a feedthrough wire, a detonator, and a switch. *Id.*; *see* page 45, *supra*. As Petitioner's illustration demonstrates, the proposed modification is not just a simple substitution of Eitschberger's

tandem sub 150 for Yonghong's connector 10. Ex. 2007 ¶ 64. Moreover, Petitioner fails to show that a simple substitution as proposed in the Reply (Pet. Reply 19) would have led a POSITA to the end contact arrangement of claim 4. Petitioner does not show that Eitschberger's tandem sub 150 includes electrical contacting component 142 that Petitioner relies upon as an "end contact" of claim 4.

In addition, Petitioner's Reply introduces several new obviousness theories that were not presented in the Petition and exceed the proper scope of a reply. 37 C.F.R. § 42.23(b); *Rembrandt*, 76 F.4th at 1383.

Petitioner argues for the first time in the Reply that "Yonghong directs a POSITA to an electrical connection as found in Eitschberger for reasons similar to those discussed for Schacherer." Pet. Reply 17 (citing Ex. 1019 ¶ 30). Similar to its arguments about Yonghong and Schacherer, Petitioner argues that Yonghong has a "ballistic connection within the charge tube shaft 6" and "Yonghong instructs how to make a connection at that point." *Id.* at 19, 20. Petitioner's reply arguments about Yonghong are new and unpersuasive for the reasons discussed above in connection with Yonghong and Schacherer. *See* pages 38–40, *supra*.

Also similar to its arguments about Yonghong and Schacherer, Petitioner argues for the first time in the Reply that "the only modification to Yonghong would be incorporating the electrical contacting component 142 on or within the charge tube shaft 6." Pet. Reply 20. Petitioner's reply argument is inconsistent with the Petition, which advocates a much more extensive modification of Yonghong (Pet. 57) and not persuasive because Petitioner does not show that merely incorporating an electrical contacting component would have provided select-fire operation in Yonghong, which is Petitioner's asserted motivation for making the modification (Pet. 51).

For the first time in the Reply, Petitioner argues as a “further motivation” that Yonghong and Eitschberger both teach pressure-sealed assemblies, and a POSITA would have substituted Eitschberger’s tandem sub and bulkhead assembly for Yonghong’s connectors 8 and 10 “because the pressure sealing and isolation is a well-known function of conventional tandem subs.” Pet. Reply 20 (citing Ex. 1019 ¶ 33). Petitioner’s reply argument is meaningfully distinct from the Petition, which argued that a POSITA would have been motivated to make this substitution “to provide select-fire operation in Yonghong while maintaining the basic configuration of components.” Pet. 51 (citing Ex. 1003 ¶ 106). The Petition does not rely on pressure-sealing or isolation as a reason for combining Yonghong and Eitschberger. Petitioner’s new motivation argument is not persuasive in any event. Petitioner does not explain how a desire for pressure-sealed and isolated downhole assemblies would have led a POSITA to combine Yonghong and Eitschberger in a manner that meets the limitation of claim 4. We see no logical connection between this newly asserted motivation and the limitation of claim 4.

In sum, Petitioner’s challenge to claim 4 based on Yonghong and Eitschberger is not persuasive for many of the same reasons discussed above for Yonghong and Schacherer. Petitioner’s Yonghong and Eitschberger challenge is even weaker because Petitioner does not show that Eitschberger discloses the end contact arrangement of claim 4. Petitioner’s combination is a hindsight reconstruction of the claim.

4. *Claim 16*

Claim 16 depends from disclaimed claim 1 and recites that the gun system further comprises “an insulated electrical contact configured to transmit electricity to the gun system.”

Petitioner acknowledges that Yonghong does not disclose the limitation of claim 16, but contends that Eitschberger does. Pet. 58 (citing Ex. 1003 ¶ 113; Ex. 1007, 4:38–50, 5:25–34, Figs. 2, 5). Petitioner relies on the same rationale for incorporating “Eitschberger’s bulkhead and electrical contact into Yonghong’s system” for claim 16 as it presents for claim 4. Pet. 50–54, 59.

Patent Owner contests the sufficiency of Petitioner’s rationale for combining Yonghong and Eitschberger, presenting the same arguments for claim 16 as discussed above for claim 4. PO Resp. 26–30.

In the Institution Decision, we did not find a reasonable likelihood that Petitioner would prevail on its challenge to claim 16 based on Yonghong and Eitschberger. Inst. Dec. 33–34. On the record now before us, we remain unpersuaded by Petitioner’s arguments and evidence. Petitioner presents no analysis for claim 16 independent of its analysis for claim 4, which is flawed for the reasons discussed in the preceding subsection. *See* Pet. 50–54, 59; Pet. Reply 17–21 (relying on the same analysis for claims 4 and 16).

For claim 16, Petitioner contends that it would have been obvious to use a bulkhead including an electrical contact configured to transmit electricity within a non-conductive bulkhead body “because those features are necessary for transferring electrical signals and insulating the electrical connection from, e.g., a tandem sub within which the bulkhead is positioned and which the bulkhead is contacting.” Pet. 59 (citing Ex. 1003 ¶ 114; Ex.

1007, Figs. 2, 5). Petitioner’s contention does not present a rationale for combining Yonghong and Eitschberger for claim 16 independent of Petitioner’s flawed analysis for claim 4. Although Petitioner and Dr. Rodgers assert that an electrical contact is “necessary for transferring electrical signals” (Pet. 59; Ex. 1003 ¶ 114), that is not a persuasive reason for adding an electrical contact to Yonghong, which uses a ballistic signal, not an electrical signal, for transferring detonation from one gun to the next. Pet. 49; Ex. 1003 ¶ 39. Thus, for claim 16, Petitioner relies on the same complicated and hindsight-biased modification of Yonghong Figure 1 as it presents for claim 4. Pet. 57, 59.

5. Conclusion

Petitioner has not shown that claims 4 and 16 are unpatentable based on Yonghong in view of Schacherer or Eitschberger.

G. Petitioner’s Hardesty-led Obviousness Challenges

Petitioner challenges claims 4 and 16 as obvious based on Hardesty in view of Schacherer or Eitschberger. Pet. 80–92. Patent Owner opposes. PO Resp. 30–32.

1. Claim 4

a) Hardesty and Schacherer

Petitioner acknowledges that Hardesty does not disclose the limitation of claim 4. Pet. 87. Petitioner contends that it would have been obvious to modify Hardesty by incorporating Schacherer’s electrical contact 54 into Hardesty’s rotatable support member. Pet. 88. Addressing reasons to combine, Petitioner contends that a POSITA “would understand that Schacherer discloses a perforating gun system that meets the need for a rotatable select-fire perforating gun system with no through wire pinch

points” and “would be motivated to modify Hardesty with the rotary electrical connection of Schacherer to obtain the benefit of a fully rotating charge assembly.” Pet. 81–82 (citing Ex. 1003 ¶ 161). Petitioner contends that its proposed modification would have simplified Hardesty’s perforating gun assembly by “eliminat[ing] the need for a coarse orientation component because the weight alone orients the explosive charges.” Pet. 82 (citing Ex. 1005, 4:7–10).

Patent Owner argues that Petitioner’s proposed combination of Hardesty with Schacherer is “meritless because the ‘benefit’ purported to motivate the combination”—a fully rotating charge assembly—“is the very aspect Hardesty expressly teaches away from.” PO Resp. 30–31 (citing Ex. 1005, 2:65–3:24; Ex. 2001 ¶ 94; Ex. 2007 ¶ 91). Patent Owner argues that “Hardesty itself teaches that a fully rotating configuration is more expensive, more complicated, less reliable, and less efficient.” *Id.* at 31.

In the Institution Decision, we did not find a reasonable likelihood that Petitioner would prevail on its challenge to claim 4 based on Hardesty and Schacherer. Inst. Dec. 35. On the record now before us, we remain unpersuaded by Petitioner’s arguments and evidence.

We agree with Patent Owner that Petitioner’s asserted reason for combining Hardesty and Schacherer is contrary to the teaching of Hardesty. PO Resp. 30–31. Petitioner proposes to eliminate Hardesty’s coarse orientation and replace it with Schacherer’s rotary electrical connections. Pet. 82. Petitioner relies on Dr. Rodgers’ testimony that “Hardesty acknowledges the benefits of a perforating system with 360° rotation of internal components” and a “POSITA would be motivated to modify Hardesty with the rotary electrical connection of Schacherer to obtain the

benefit of a fully rotating charge assembly.” Ex. 1003 ¶ 161 (cited at Pet. 82).

Petitioner’s proposed modification and rationale are directly contrary to Hardesty, which teaches that fully rotating charge assemblies have disadvantages and teaches an improvement to such systems. Hardesty describes at length the shortcomings of prior art perforating guns with internally-orienting weighted charge assemblies that can rotate 360 degrees. Ex. 1005, 2:61–3:24, 3:44–55. These disadvantages include the cost and failure rate of bearings and rollers (*id.* at 2:62–3:11, 3:41–43), inability to use a through wire for connecting select fire switches (*id.* at 3:12–20, 3:53–55), reduced maximum charge size and number of charges as compared to conventional guns with equivalent diameter (*id.* at 3:21–29, 3:44–48), and inability to adjust to deviations in the wellbore casing or straightness in perforating gun (*id.* at 3:30–32, 3:49–52). *See also* Ex. 2007 ¶ 91 (Dr. Wooley’s testimony summarizing Hardesty’s disclosure of problems associated with a fully rotating charge assembly).

Hardesty specifically criticizes fully rotating charge assemblies for select fire applications, as follows:

For a pump down select fire application, full rotation (360°) prevents the use of a through wire to connect subsequent select fire switches to the firing train. The rotating internal components may sever the wire, or require a rotating junction, both of which decrease reliability of the gun system. Therefore there is a need for a limited internal motion gun that would allow the wire to be positioned such that no pinch point exists.

Ex. 1005, 3:12–20. The above-quoted passage from Hardesty directly contradicts Petitioner’s contention and Dr. Rodgers’ testimony that a POSITA would have been “motivated to modify Hardesty with the rotary electrical connection of Schacherer to obtain the benefit of a fully rotating

charge assembly.” Pet. 81–82; Ex. 1003 ¶ 161. We are persuaded by Dr. Wooley’s testimony that “the precise modification proposed by Petitioners and Dr. Rodgers – a rotating electrical connection – is expressly considered by Hardesty and **dismissed** because it would ‘decrease reliability of the gun system.’” Ex. 2007 ¶ 92 (citing Ex. 1005, 3:14–16). Petitioner’s asserted reason for combining Hardesty and Schacherer is not consistent with the evidence.

Petitioner’s simplification rationale (Pet. 82) is also contrary to Hardesty, which teaches a coarse external orientation as part of a solution for overcoming the various disadvantages of full rotation. Ex. 1005, 3:56–59, 4:25–55. Petitioner’s argument that a POSITA would have been motivated to eliminate a key feature of Hardesty’s solution is not persuasive.

Petitioner’s reply arguments are equally unpersuasive. Petitioner relies on Hardesty’s statement that full rotation “has the advantage of greater accuracy” (Pet. Reply 22 (citing Ex. 1005, 2:65–3:2)), but ignores the context of this statement, which plainly conveys that greater accuracy is outweighed by numerous disadvantages, as detailed above. Ex. 1005, 2:61–3:24, 3:44–55. Next, Petitioner argues that full rotation would “*allow* ‘the use of a through wire to connect subsequent select fire switches.’” Pet. Reply 23 (citing Ex. 1005, 3:12–14; emphasis added). That argument is directly contrary to Hardesty’s teaching that “full rotation (360°) *prevents* the use of a through wire to connect subsequent select fire switches.” Ex. 1005, 3:12–14 (emphasis added). Next, Petitioner argues that “Hardesty directs a POSITA precisely to a system such as Schacherer with a more reliable ‘rotating junction.’” Pet. Reply 23 (citing Ex. 1005, 3:14–19; Ex. 1019 ¶ 38). Again, Petitioner’s argument is directly contrary to Hardesty, which teaches that “a rotating junction . . . *decrease[s]* reliability

of the gun system.” Ex. 1005, 3:15–17 (emphasis added). We find these last two reply arguments are particularly unpersuasive because they directly contradict Hardesty’s express teachings.

Petitioner argues that “whether the combination of Hardesty and Schacherer motivates or achieves a full, 360-degree rotating assembly” is not in question “because none of the challenged claims recite a degree of rotation.” Pet. Reply 23. Petitioner’s reply argument is inconsistent with the Petition, which puts a full, 360-degree rotating assembly at issue by relying upon that feature as a reason for modifying and combining the references. Pet. 81–82. It is Petitioner’s burden to prove that a POSITA would have had a reason to combine the prior art teachings, and Petitioner chose “the benefit of a fully rotating charge assembly” (Pet. 82) as the primary reason.

Finally, Petitioner argues that a POSITA would understand that Hardesty’s “‘tandems or subs or transfers’ 104, 408, 416” “can be substituted with Schacherer’s connector 30b.” Pet. Reply 24 (citing Ex. 1005, 2:2–4, 6:50–57, 7:19–21; Ex. 1019 ¶ 39). Petitioner fails to show that the proposed substitution would have resulted in the end contact arrangement of claim 4. Schacherer’s electrical contact 54, alleged to be the “end contact” of claim 4 (Ex. 1003 ¶¶ 46, 110), is not part of Schacherer’s connector. Ex. 1006, 4:27–31 (electrical contact 54 rotates with the explosive components while “electrical contact 56 is stationary, along with the remainder of the connector 30b”), Fig. 2.

a) Hardesty and Eitschberger

Petitioner contends that it would have been obvious to incorporate Eitschberger’s detonator electrical contacting component 142 into Hardesty’s system for transferring a signal to a select-fire detonator within

the charge tube. Pet. 89–90 (citing Ex. 1003 ¶ 172; Ex. 1007, 7:64–8:4, Fig. 5).¹⁴ Addressing reasons to combine, Petitioner contends that the references disclose similar shortcomings and a POSITA would have been “motivated to incorporate Eitschberger’s electrical feedthrough assembly into Hardesty’s select-fire perforating gun system at least because Hardesty’s configuration is complementary to Eitschberger’s FIG. 5.” Pet. 83, 86. According to Petitioner, this combination would have been “straightforward” and “predictable.” Pet. 86. In addition, Petitioner argues that “Eitschberger’s single centerline pin contact provides the benefit of a low-friction electrical connection allowing free rotation of the charge tube in the gravity-oriented system.” Pet. 87 (citing Ex. 1003 ¶ 167).

Patent Owner presents the same arguments for Petitioner’s Hardesty-Eitschberger combination as it presents for Petitioner’s Hardesty-Schacherer combination. PO Resp. 30–31. In addition, Patent Owner argues that Eitschberger does not teach the limitation of claim 4, and a POSITA would not have ignored the express teachings of Hardesty and modified the disclosed device to include a fully rotating gun body and an entirely different type of electrical connection. *Id.* at 32.

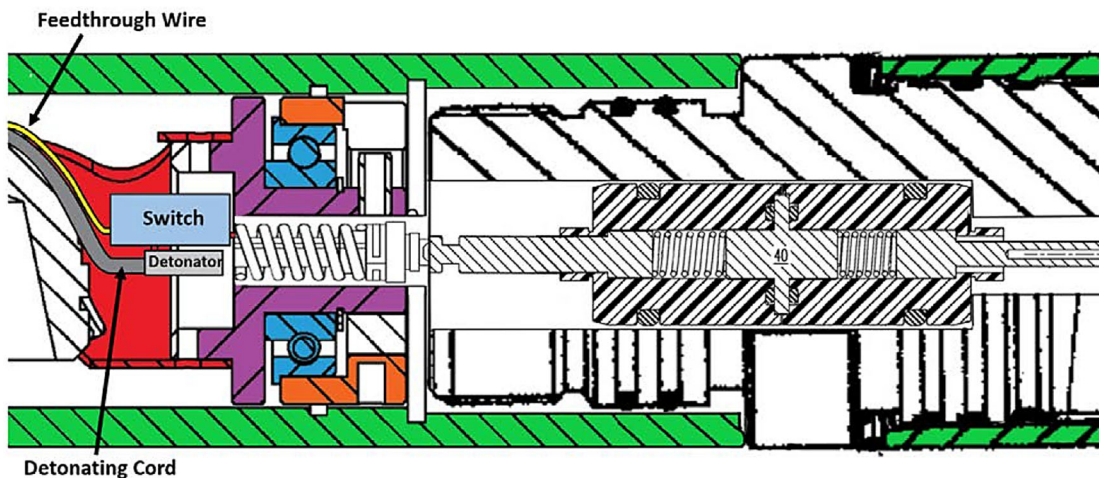
In the Institution Decision, we did not find a reasonable likelihood that Petitioner would prevail on its challenge to claim 4 based on Hardesty and Eitschberger. Inst. Dec. 37. On the record now before us, we remain

¹⁴ Petitioner begins its argument about Eitschberger with the phrase, “[i]n addition, or in the alternative.” Pet. 89. Because Petitioner does not present argument or evidence to support a three-reference combination, we limit our discussion to Petitioner’s two-reference combinations, Hardesty and Schacherer or Hardesty and Eitschberger.

unpersuaded by Petitioner's arguments and evidence for two separate reasons.

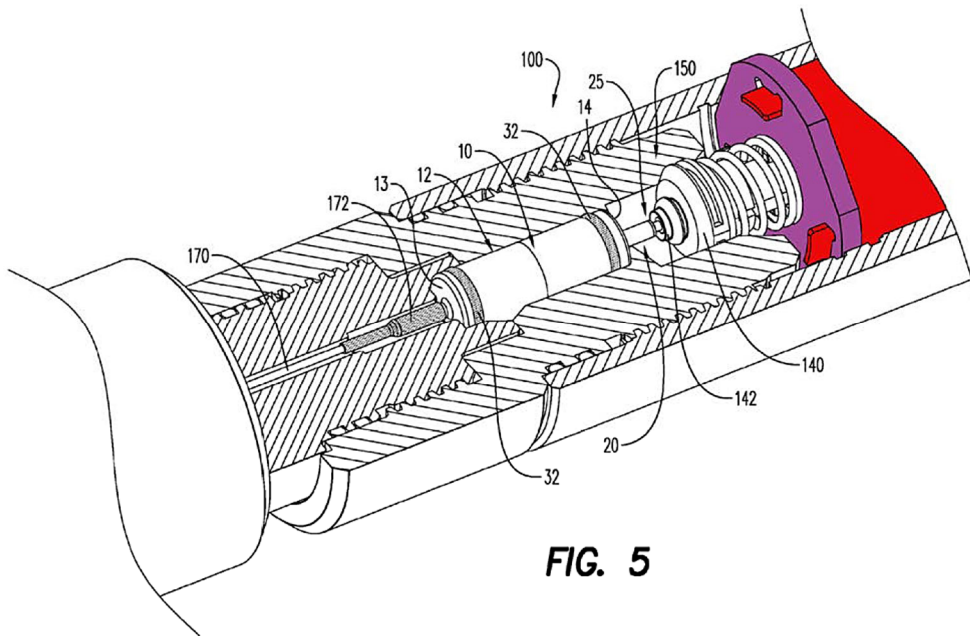
First, Petitioner's reason for combining Hardesty and Eitschberger is contrary to the teaching of Hardesty. Petitioner and Dr. Rodgers assert that Eitschberger's electrical contact would provide the benefit of "free rotation of the charge tube in the gravity-oriented system." Pet. 87; Ex. 1003 ¶ 167. As discussed in the preceding subsection, however, Hardesty teaches that fully rotating charge assemblies have many disadvantages (Ex. 1005, 2:61–3:24, 3:44–55) and specifically teaches that the modification proposed by Petitioner—a rotating electrical connection—would decrease reliability of the gun system. *Id.* at 3:14–16; Ex. 2007 ¶ 92.

Second, Petitioner fails to provide a persuasive rationale for combining Hardesty and Eitschberger in a way that meets the limitation of claim 4. Referring to the color-coded figure reproduced below, Petitioner contends it would have been "obvious to position the electrical contacting component of Eitschberger within the opening through the support member (purple) (and thus also through the collar (orange) and bearing assembly (blue)) at the end of the charge tube (red) of Hardesty, according to Eitschberger." Pet. 90 (citing Ex. 1003 ¶ 172).



Pet. 90; Ex. 1003 ¶ 172. Hardesty Figure 7 shows a perforating gun, which Petitioner has modified to include connector 10 of Yonghong Figure 1, bulkhead assembly 10 of Eitschberger Figure 2, initiator (detonator or igniter) 140 from Eitschberger Figure 5, a detonating cord, a feedthrough wire, a detonator, and a switch. Petitioner and Dr. Rodgers do not provide a reason for arranging the prior art components in the manner shown in their composite figure.

Referring to the color-coded version of Eitschberger Figure 5 reproduced below, Petitioner and Dr. Rodgers assert that Eitschberger discloses “a detonator or initiator positioned within a charge tube (red).” Pet. 84, 89; Ex. 1003 ¶¶ 165, 172 (citing Ex. 1007, 7:64–8:4, Fig. 5).



Pet. 85; Ex. 1003 ¶ 165. Eitschberger Figure 5 shows a perforating gun assembly. We find no support in Eitschberger for Petitioner’s assertion that a detonator or igniter is positioned within a charge tube. Figure 5 shows detonator or igniter 140 *outside* of the red structure Petitioner identifies as a charge tube.

In the Reply, Petitioner argues that “a POSITA would readily understand that Eitschberger’s electrical contacting component 142 could be integrated into Hardesty’s end plate in the same manner that Eitschberger shows for providing an electrical signal to an initiator—i.e., a detonator—within a gun body to which the end plate is attached.” Pet. Reply 26–27 (citing Ex. 1018, 63:13–64:3; Ex. 1019 ¶¶ 43, 44). Petitioner’s reply argument is based on the same unsupported assertion about Eitschberger as set forth in the Petition. Pet. 84, 89. Eitschberger does not support Petitioner’s assertion that a detonator or igniter is positioned within a gun body.

Eitschberger also does not support Petitioner’s modification of Hardesty Figure 7. Petitioner inserts Eitschberger’s electrical contacting component 142 *within* Hardesty’s charge holder tube (purple) and adds a switch and detonator within the charge tube. Pet. 90; Ex. 1003 ¶ 172. In contrast, Eitschberger Figure 5 shows detonator electrical contacting component 142 completely *outside* of the purple structure Petitioner identifies as an end cap. Pet. 85; Ex. 1003 ¶ 165; Ex. 1007, 7:64–8:4, Fig. 5. Petitioner and Dr. Rodgers do not provide a reason for arranging an electrical contact, switch, and detonator in the manner shown in their modification of Hardesty Figure 7. Pet. 90; Ex. 1003 ¶ 172. In the absence of such a reason, “we are left with only hindsight bias that *KSR* warns against.” *Metalcraft of Mayville, Inc. v. Toro Co.*, 848 F.3d 1358, 1367 (Fed. Cir. 2017) (“[W]e cannot allow hindsight bias to be the thread that stitches together prior art patches into something that is the claimed invention.”).

In addition, Petitioner argues that Hardesty Figure 5 discloses an end plate having the same position and/or function as the support member in

Figure 7 and the alleged end cap in Eitschberger Figure 5. Pet. Reply 25–26 (citing Ex. 1019 ¶¶ 41, 42; Ex. 1005, 7:51–53, 8:65–9:2, 9:61–65, Figs. 5, 7). Petitioner argues that “[t]he fact that Hardesty expressly discloses an ‘end plate’ according to the position and function of the support member would provide a POSITA with *additional motivation* for incorporating Eitschberger’s electrical contacting component 142 through Eitschberger’s end cap in Hardesty’s support member/end plate.” *Id.* at 27 (citing Ex. 1019 ¶¶ 41–44; emphasis added). Petitioner’s argument is not supported by Dr. Rodgers’ testimony and is not persuasive. Petitioner does not persuade us that Hardesty’s disclosure of an end plate would have provided a motivation to arrange an end contact “at least partially disposed through the collar and the bearing assembly,” as recited in claim 4.

2. Claim 16

Petitioner acknowledges that Hardesty does not disclose the limitation of claim 16, but contends that Eitschberger does. Pet. 91 (citing Ex. 1003 ¶¶ 175, 176). Petitioner relies on the same rationale for incorporating “Eitschberger’s bulkhead and electrical contact into Hardesty’s system” for claim 16 as it presents for claim 4. Pet. 83–87, 91.

Patent Owner contests the sufficiency of Petitioner’s rationale for combining Hardesty and Eitschberger, presenting the same arguments for claim 16 as discussed above for claim 4. PO Resp. 30–32.

In the Institution Decision, we did not find a reasonable likelihood that Petitioner would prevail on its challenge to claim 16 based on Hardesty and Eitschberger. Inst. Dec. 38. On the record now before us, we remain unpersuaded by Petitioner’s arguments and evidence. Petitioner presents no analysis for claim 16 independent of its analysis for claim 4, which is flawed

for the reasons discussed in the preceding subsection. *See* Pet. 83–87, 91; Pet. Reply 24–27 (relying on the same analysis for claims 4 and 16).

For claim 16, Petitioner contends that it would have been obvious to use a bulkhead including an electrical contact configured to transmit electricity within a non-conductive bulkhead body “because those features are respectively necessary for transferring electrical signals and insulating the electrical connection from, e.g., a tandem sub within which the bulkhead is positioned and in contact.” Pet. 92 (citing Ex. 1003 ¶¶ 114 n.4, 177). Petitioner’s contention does not present a rationale for combining Hardesty and Eitschberger for claim 16 independent of Petitioner’s flawed analysis for claim 4. Although Petitioner and Dr. Rodgers assert that an insulated electrical contact is “necessary for transferring electrical signals and insulating the electrical contact,” the only insulated electrical contact they point to is Eitschberger’s rotating electrical contact. Pet. 91–92; Ex. 1003 ¶¶ 176, 177. For the reasons discussed above, modifying Hardesty to include a rotating electrical contact would have been contrary to the teaching of Hardesty.

3. Conclusion

Petitioner has not shown that claims 4 and 16 are unpatentable based on Hardesty in view of Schacherer or Eitschberger.

H. Alleged Obviousness Based on Hardesty and Yonghong

Petitioner challenges claims 3, 7, 24–26, 29, 30, and 34–36 as obvious based on Hardesty and Yonghong. Pet. 92–102. Patent Owner opposes. PO Resp. 38–39.

Because we determine that Petitioner has shown that claims 3, 7, 24–26, 29, 30, and 34–36 are anticipated by each of Yonghong and

Hardesty, we do not reach Petitioner’s challenge to these same claims based on a combination of Yonghong and Hardesty. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. 2020) (nonprecedential) (“We agree that the Board need not address [alternative grounds] that are not necessary to the resolution of the proceeding.”).

III. CONCLUSION¹⁵

In summary:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatent- able
3, 7, 24–26, 29, 30, 34–36	102(a)(1)	Yonghong	3, 7, 24–26, 29, 30, 34–36	
4, 16	103	Yonghong, Schacherer		4, 16
4, 16	103	Yonghong, Eitschberger		4, 16
3, 7, 24–26,	102(a)(1)	Hardesty	3, 7, 24–26,	

¹⁵ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatent- able
29, 30, 34–36			29, 30, 34–36	
4, 16	103	Hardesty, Schacherer		4, 16
4, 16	103	Hardesty, Eitschberger		4, 16
3, 7, 24–26, 29, 30, 34–36	103 ¹⁶	Hardesty, Yonghong		
Overall Outcome			3, 7, 24–26, 29, 30, 34–36	4, 16

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown that claims 3, 7, 24–26, 29, 30, 34–36 of the '762 Patent are unpatentable;

FURTHER ORDERED that Petitioner has not shown that claims 4 and 16 of the '762 Patent are unpatentable; and

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

¹⁶ We do not reach Petitioner's obviousness challenge based on Yonghong and Hardesty because we determine that Petitioner has shown that claims 3, 7, 24–26, 29, 30, and 34–36 are anticipated by each of Yonghong and Hardesty.

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