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Paper 19
Entered: April 11, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

QINETIQ LIMITED,
Patent Owner.

PGR2023-00003
Patent 11,215,039 B2

Before WILLIAM V. SAINDON, WILLIAM A. CAPP, and CARL M. DeFRANCO, *Administrative Patent Judges.*

Opinion for the Board filed by CAPP, *Administrative Patent Judge*

Opinion Concurring filed by DeFRANCO, *Administrative Patent Judge*

Opinion Dissenting filed by SAINDON, *Administrative Patent Judge*

CAPP, *Administrative Patent Judge.*

JUDGMENT

Final Written Decision

Determining No Challenged Claims Unpatentable

35 U.S.C. § 328(a)

I. BACKGROUND

Dynaenergetics Europe GmBH and Dynaenergetics US, Inc. (collectively "Petitioner") filed a Petition (Paper1, "Pet.") requesting post-grant review of claims 1–5 of U.S. Patent No. 11,215,039 B2 (Ex. 1001, the '039 patent). Patent Owner, QinetiQ Limited, has elected not to file a Patent Owner Response.

Notwithstanding the lack of Patent Owner Response, in order to prevail, Petitioner bears the burden to demonstrate that the challenged claims are unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016). This burden never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in inter partes review). The standard of proof is preponderance of the evidence. 35 U.S.C. § 326(e); 37 C.F.R. § 42.1(d). We have jurisdiction under 35 U.S.C. § 6.

Having conducted a trial on the merits including a regularly scheduled oral hearing on January 11, 2024, we conclude that Petitioner has not demonstrated that any challenged claim of the '039 Patent is more likely than not unpatentable under any and all of the grounds of unpatentability asserted in the Petition. Accordingly, we hereby enter a Final Written Decision and Judgment in favor of the Patent Owner as to claims 1–5. *See* 35 U.S.C. § 328(a).

II. RELATED MATTERS AND REAL PARTIES IN INTEREST

The parties represent that there are no other related matters currently pending between the parties. Pet. 1; Paper 5 (Patent Owner's Mandatory Notice). Petitioner represents that Dynaenergetics Europe GmBH and

Dynaenergetics US, Inc. are its real parties in interest. Pet. 1. Patent Owner represents that QinetiQ Limited is its real party in interest. Paper 5.

III. PGR ELIGIBILITY

The '039 patent, entitled "Shaped Charge and Method of Modifying a Shaped Charge" issued from application number 15/930,939. The '939 Application, in turn, is a continuation of application number 16/704,524 (now U.S. Pat. No. 11,002,118), which is a continuation of application number 14/651,829 (now U.S. Pat. No. 10,533,401), which was filed on December 13, 2013. Ex. 1001. The '829 Application is a National Stage entry of PCT/EP2013/076578 which was published as WO 2014/091004, pub. June 19, 2014, and claims priority to application number GB 1222474 filed Dec. 13, 2012. *Id.* Thus, the filing date of the GB '474 application predates the March 16, 2013, statutory effective file date requirement of the America Invents Act. AIA § 3(n)(1).

Petitioner asserts that the '039 patent is eligible for post-grant review. Pet. 3–8. Patent Owner does not contest this issue. Patent Owner did file a motion to dismiss the Petition alleging that Petitioner was untimely in serving the Petition under circumstances that allegedly caused the Petition to be untimely filed in contravention of 35 U.S.C. § 321(c). Paper 6. After briefing by the parties and due consideration by the Board, a majority of the Board panel denied the motion to dismiss by Order entered April 13, 2023. Paper 8. At the hearing, Petitioner disclaimed knowledge of any new and intervening legal authorities that might tend to affect the outcome of decision denying the motion to dismiss. Tr. 36:18–26.

IV. BACKGROUND

A. The '039 patent (Ex. 1001)

The Specification of the '039 patent generally discloses a perforator used in fracking procedures in the oil and gas industry. Ex. 1001, 2:19–44. Figure 1 below depicts a known perforator design.

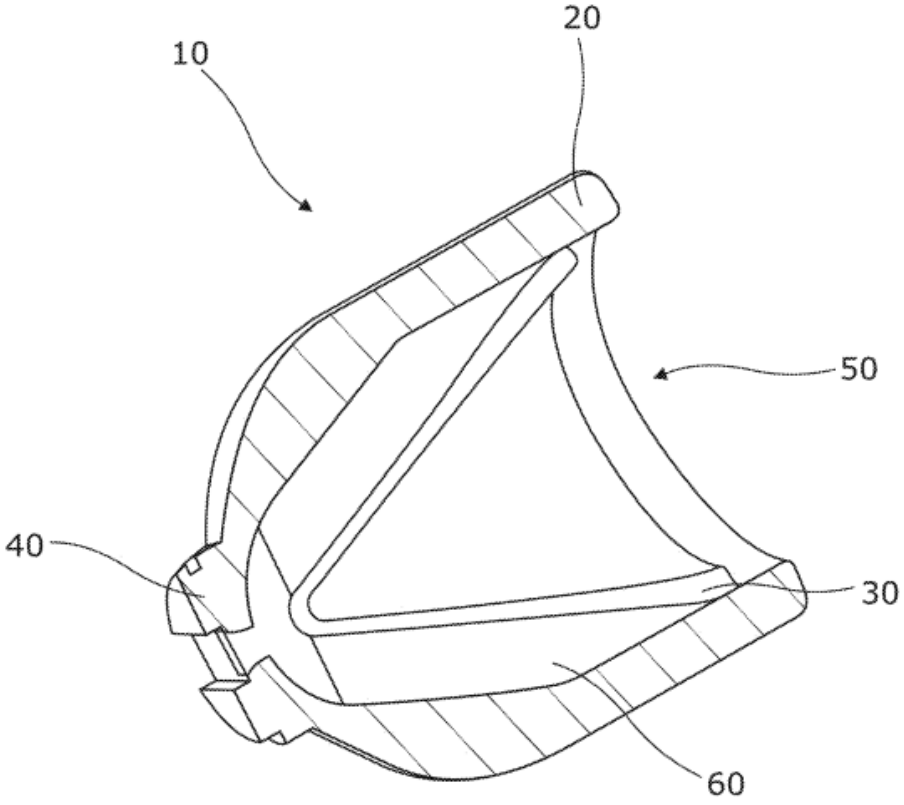

FIGURE 1 OF THE ''039 PATENT

As depicted in Figure 1 above, known perforators comprise charge case 20, explosive composition 60, and liner 30. Ex. 1001, Fig. 1. Challenged claims 1–5 relate to designing variations in the shape of the liner component. *Id.* The Specification describes an iterative design process that includes compilation of a library of liner designs, each of which is associated with a particular perforation tunnel geometry determined by test firings or computer simulation. *Id.* at 11:5–12:63.

Figure 5 of the '039 Patent is reproduced below.

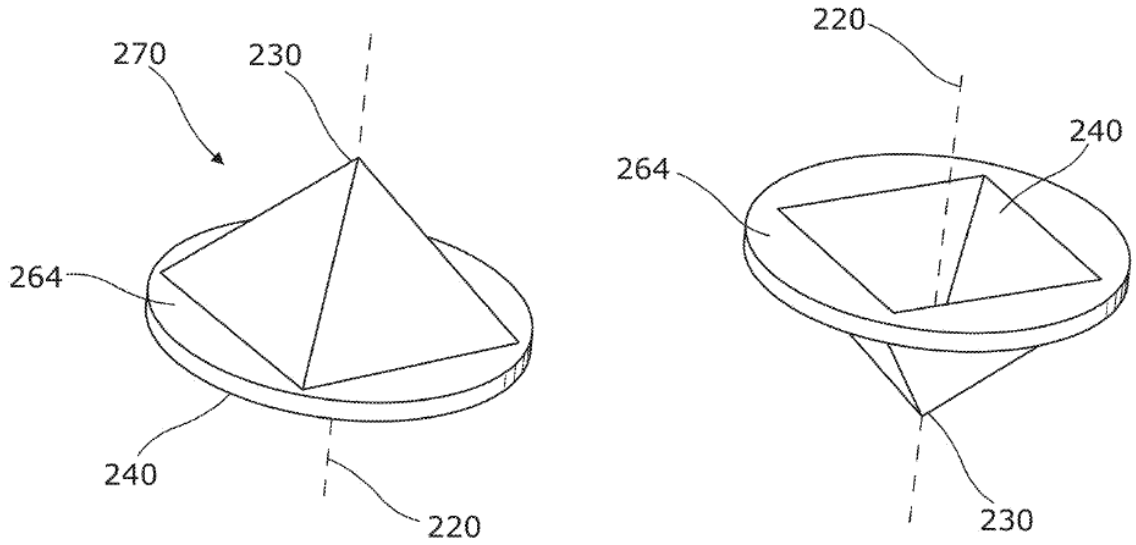

FIGURE 5 OF '039 PATENT

Figure 5 above depicts side-by-side respective upper and lower perspective views of a shaped charge liner that adopts the shape of a pyramid surrounded circumferentially by a circular lip.

B. The Challenged Claims

Petitioner challenges claims 1–5. Independent claim 1 is representative of the claimed subject matter and is reproduced below:

> 1. A method of manufacturing an enhanced shaped charge liner design for use in an oil/gas well perforator that is usable to form a desired hole shape in a rock formation, the method comprising
>
> comparing the desired hole shape to a library of known liner designs, the library including data relating to a hole shape formed by each of the known liner designs within the library;
>
> selecting a liner design from the known liner designs that produces a hole shape optimised to the desired hole shape;
>
> varying at least one parameter of the selected liner design to form a modified liner design;
>
> modelling the hole shape that the modified liner design produces;

repeating the varying and modelling steps until the hole shape of the modified liner design converges towards the desired hole shape to thereby create a final liner design; and

forming the enhanced shaped charge liner in accordance with the final liner design.

C. The Asserted Grounds of Unpatentability

Petitioner asserts 12 grounds of unpatentability, which are summarized in the following table. The various grounds of unpatentability are supported by the Declaration of Marco Serra (Ex. 1003).

Claims	§	References[1]/Basis
1-5	101	Subject Matter Eligibility
1-5	112(b)	Indefiniteness
1-5	112(a)	Non-Enablement
1-5	112(a)	Lack of Written Description
1-5	102	Davison (Ex. 1009)
2-4	103	Davison (Ex. 1009), Quattlebaum (Ex. 1007)
2-4	103	Davison (Ex. 1009), Walters (Ex. 1014)
5	103	Davison (Ex. 1009), Smith (Ex. 1015)
1	102	Guinot (Ex. 1010)
1-4	103	Guinot (Ex. 1010), Quattlebaum (Ex. 1007)
2-4	103	Guinot (Ex. 1010), Walters (Ex. 1014)
5	103	Guinot (Ex. 1010), Smith (Ex. 1015)

[1] A more detailed description of the listed prior art references is set forth in pages 17–28 of the Petition.

V. CLAIM INTERPRETATION

In trial proceedings under the America Invents Act, we apply the same claim construction standard that is applied in civil proceedings under 35 U.S.C. § 282(b). *See* 37 C.F.R. § 42.100(b); *Cupp Computing AS v. Trend Micro Inc.*, 53 F.4th 1376, 1380 (Fed. Cir. 2022) citing *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc); *Polaris Innovations Ltd. v. Brent*, 48 F.4th 1365, 1372 n.3 (Fed. Cir. 2022).

A claim construction analysis begins and remains centered on the claim language itself. *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed. Cir. 2004). The words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the applicable art at the time of the invention. *Phillips*, 415 F.3d at 1312–13. We construe claim language in the context of the claim in which it appears. *IGT v Bally Gaming, Intl, Inc.*, 659 F.3d 1109, 1117 (Fed. Cir. 2011). Furthermore, the person of ordinary skill in the art is also deemed to read the claim term in the context of the entire patent, including the specification. *Id.; see also Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979 (Fed. Cir. 1995) (*en banc*), *aff'd*, 517 U.S. 370 (1996) (explaining the claims "must be read in view of the specification, of which they are a part"). The specification may define claim terms by implication such that the meaning may be ascertained by reading the patent documents. *Phillips*, 415 F.3d at 1321. The specification is generally the single best guide to the meaning of a disputed term, and usually, it is dispositive. *Id.* at 1315.

Petitioner submits testimony from Mr. Serra in support of its proposed claim construction. Serra (Ex. 1003) ¶ 46. Extrinsic evidence, such as

expert testimony, can be useful for a variety of purposes, such as to provide background on the technology at issue, to explain how the invention works, to ensure that the court's understanding of technical aspects of a patent is consistent with that of person of skill in the art, or to establish that a particular term in a patent or the prior art has a particular meaning in the pertinent field. *Phillips*, 415 F.3d at 1319. However, extrinsic evidence is generally considered less reliable than the patent and its prosecution history in determining how to read the claim terms. *Id.*[2]

In the Petition, Petitioner proposes constructions for two claim terms, subject to the qualification that they are not found to be indefinite. Pet. 31–33.

1. Optimized[3]

Petitioner asserts that the term "optimized" renders claim 1 indefinite. Pet. 31, 45. An analysis of claim indefiniteness is inextricably intertwined with claim construction. *Energizer Holdings, Inc. v. Int'l Trade Com'n*, 435 F.3d 1366, 1368 (Fed. Cir. 2006).

The Specification teaches a method to design and form a shape charge liner that produces a "desired" hole shape. Ex. 1001, 6:9, 11:43. A person of ordinary skill would understand that a designer approaches a design project with an objective in mind, namely a hole shape that is "desired."

[2] Undue reliance on extrinsic evidence poses the risk that it will be used to change the meaning of claims in derogation of the "indisputable public records consisting of the claims, the specification and the prosecution history," thereby undermining the public notice function of patents. *Phillips*, 415 F.3d at 1319 (citing *Southwall Techs., Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1578 (Fed. Cir. 1995)).

[3] The '039 Patent uses the alternative spelling "optimised." Ex 1001, 13:11. We will use the spelling "optimized" throughout this Decision.

Thus, the "desired" hole shape is a predetermined concept or construct that is a given at the beginning of the design process and becomes the goal or objective of the design process. This desired hole shape then serves as a standard for comparison during two phases of the design process. First, it is a standard of comparison that is used in the initial selection of a candidate liner as the starting point for the design process. Ex. 1001, 13:6–9. It is understood that the selection is not made at random. Instead, it is understood that there are attributes of the geometry of a hole shape produced by a particular known liner that, upon comparison with the "desired hole shape," lends the particular known liner as a more likely candidate for the start of the iterative design process than other known liners. Second, the "desired hole shape" is a standard of comparison for holes produced by modified liners during the iterative design process. *Id.* at 13:18–19.

The Specification teaches that liner geometry can be customized such that desirable perforation tunnel geometric features are created, including features such as geometries that: (1) promote fracture initiation and propagation; (2) promote fracture initiation and growth in a specific orientation; (3) promote maximum flow/flow rate from the rock. Ex. 1001, 11:7–9. Parameters of a desired hole may comprise hole depth and general hole profile, such as a slot-like cross-section. *Id.* at 12:25–30. The variability and irregularity in the geometry of a perforation tunnel generated by a shaped charge is illustrated in Figures 9A-D. Ex. 1001, p. 11. At step 416 of an exemplary method, a liner is chosen that results in a hole that is "closest" to the desired hole shape. Ex. 1001, 12:42–44, Fig. 17.

Furthermore, prosecution history can inform claim construction by demonstrating how the inventor understood the invention. *Personalized*

Media Communications, LLC v. Apple Inc., 952 F.3d 1336 (Fed. Cir. 2020). During prosecution, the Examiner rejected claim 1 as indefinite by virtue of its recital of the word "closest." Ex. 1002, p. 57. The Examiner treated "closest" as a term of degree and maintained that the Specification did not provide a standard for ascertaining the requisite degree. *Id.* In response, Patent Owner amended claim 1 to recite selecting a liner design that produces a hole shape that is "optimized" to the desired hole shape in lieu of a design that produces a hole shape that is "closest" to the desired hole shape. *Id.* p. 35. In the accompanying remarks, Patent Owner states that the claim amendment was made to overcome the indefiniteness rejection. *Id.* p. 41. Approximately three weeks after receiving the amendment, the Examiner issued a Notice of Allowance. *Id.* p. 7. In the accompanying Notice of Allowability, the Examiner commented that Patent Owner's response to the indefiniteness rejection had been persuasive in overcoming the rejection. *Id.* p. 12.

In the instant case, Petitioner proposes that, if we determine that the term is definite, we construe a hole shape from a known liner design as "optimized" to a desired hole shape if it "differs the least" from the desired hole shape in comparison to that of other liner shape designs in the library of known known liner designs. Pet. 31. However, in view of the prosecution history, I[4] do not adopt Petitioner's proposed construction. *Id.* Petitioner's proposed construction ("*differs the least*") strikes me as an equivalent

[4] In this majority opinion, "I" refers to Judge Capp and "we" refers to Judge Capp with one or more of Judges Saindon and DeFranco, as will be made clearer when read in conjunction with their separate opinions.

expression to the "closest" term that drew a rejection by the Examiner as a term of degree and, therefore, suffers from a similar infirmity.

Prior art references can "help demonstrate how a disputed term is used by those skilled in the art." *Arcelormittal France v. AK Steel Corp.*, 700 F.3d 1314, 1322 (Fed. Cir. 2012). Various forms of the term "optimize" appear in at least three references relied on by Petitioner. One of the conclusions reached by Quattlebaum's study is that "[s]haped charge jet perforators can be *optimized* for a given set of conditions." Quattlebaum (Ex. 1007), p. 12 (emphasis added). Guinot states that its invention "relates to a method of controlling the production of sand, based on *optimizing the geometry* and the orientation of perforations. Guinot (Ex. 1010) 3:35–37 (emphasis added). Smith concludes that perforating penetration in high compressive rocks can be increased by *optimizing* the perforator geometric design. Smith (Ex. 1015) p. 6 (emphasis added). Furthermore, the Davison reference uses the term "most promising" instead of "optimized," however, a person of ordinary skill in the art would understand the two terms to be substantially equivalent in meaning. Davison (Ex. 1009), p. 4.

Moreover, it is understood from reading the industry literature that, in the current state of the art, describing and comparing the geometry of a perforation tunnel does not lend itself to mathematical precision and certainty. Smith states that "a detail understanding of the penetration physics is insufficient to predict penetration performance from first principles without the use of empirical data." Smith (Ex. 1015) p. 2. Due to the nature of the field of endeavor, it appears that practitioners frequently need to rely on qualitative data, because quantitative data is not available. Smith (Ex. 1015) p. 3.

Petitioner's expert, Mr. Serra, offers an opinion that claim 1 is indefinite on account of use of the "optimized" term. Ex 1003 ¶¶ 69–79. Mr. Serra testifies that perforation holes can vary in many respects, including hole geometry, entry hole diameter, depth, degree of taper, and volume. *Id.* ¶ 78. Mr. Serra acknowledges that variability in perforation holes is a foundational premise of the '039 Patent and the iterative process of liner design. *Id.* Mr. Serra's testimony is useful in helping me understand the variability and, to a certain degree, lack of mathematical certainty, both in describing the shape of a perforation tunnel as well as in predicting the shape of a perforation tunnel by varying the parameters of a liner design. Mr. Serra's testimony reinforces my understanding that there is a certain amount of variability and unpredictability in creating a hole in rock strata using a jet created by an explosive charge and pressed metal powder.

Otherwise, however, Mr. Serra's testimony is not particularly helpful to me in construing the claim. *Teva Pharmaceuticals USA, Inc. v. Sandoz, Inc.*, 574 U.S. 318, 332 (2015) (explaining that an expert may explain terms of art and the state of the art, but cannot be used to prove the proper or legal construction of any instrument of writing). Among other things, Mr. Serra fails to take into account that the definiteness requirement contemplates that absolute precision is often unobtainable owing to the inherent limitation of language. *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 908–910 (2014). Furthermore, I note a certain inconsistency in Mr. Serra's testimony, who appears to have no difficulty in understanding what the term "optimize" means to a person of ordinary skill in the art as it is used in the prior art references cited against the challenged claims. Mr. Serra's testimony provides me with no indication that there is a more definite way of using the

English language to describe the phenomenon of selecting a candidate liner design than the claim language chosen by the inventors. The situation I am confronted with is comparing the shape of one irregularly shaped hole to other irregularly shaped holes. That situation does not appear to me to lend itself to any more precision than I find in Patent Owner's claims.

Taking into account the surrounding context of how "optimized" is used in claim 1, together with the teachings of the Specification, the prosecution history, and usage of the term in analogous prior art references, I construe the term "*optimized*" as relating to a hole shape associated with a known liner design, where such hole shape more closely approximates one or more parameters of a desired hole shape when compared to hole shapes that are associated with other liner designs that are maintained in a library. This construction contemplates that aspects of the comparison may be, at least to some extent, qualitative in nature. The construction further contemplates that the object of the comparison is to select a promising candidate for beginning of the iterative design process contemplated by the remaining steps in the design process of claim 1 when compared to other liners in the library.

2. *Converge*

As with the "*optimized*" term, Petitioner asserts that the phrase "*converges towards the desired hole shape*" renders claim 1 indefinite. Pet. 31–33, 45–46. However, for purposes of its prior art grounds of unpatentability, Petitioner proposes that the hole shape of the "modified liner design" is considered to be more similar in any quantifiable respect to the "desired hole shape" than the hole produced by the "known liner design." *Id.* at 32.

The Specification states that, at step 422 of the Figure 17 method, the hole produced by the modified liner design is compared again to the desired hole profile. Ex. 1001, 12:52–53. Certain design steps may then be repeated until the liner performance shows no further, appreciable improvement. *Id.* at 12:53–57. At this point, the modified liner performance is considered to have "converged" towards the desired hole shape. *Id.* at 12:58–59.

Many of the considerations that we discussed hereinabove with respect to the qualitative nature of data analysis in this field of endeavor with respect to the term "optimized" apply with equal force to the claim term "converge." The shaped charges used in this industry tend to create holes in concrete and/or rock formations that have manifestly irregular shapes. Furthermore, the hole shape created in concrete of a particular liner may vary from the hole shape created by the same liner in a rock formation. As the liner design is changed, the modified liner tends to produce an irregularly shaped hole that is different from the irregularly shaped hole created by another liner. As compared with the irregularly shaped hole produced by a previously used liner, the designer is interested in whether the irregularly shaped hole produced by the most recent liner in the iterative design process is more similar, as opposed to less similar, to the desired hole shape. A hole that is more similar to the desired hole shape than holes produced by previously tested liners may be said to "converge" toward the desired shape. Similarly, a hole that is less similar may be said to "diverge" from the desired shape. Due to the irregularity of the shapes produced, it is understood that this process does not lend itself readily to quantitative analysis, neither does it lend itself to making determinations with mathematical certainty. Once again, we are mindful that the definiteness

requirement must take into account that absolute precision is often unobtainable owing to the inherent limitation of language. *Nautilus,* 572 U.S. at 908–910.

Once again, prior art can "help demonstrate how a disputed term is used by those skilled in the art." *Arcelormittal*, 700 F.3d at 1322. A design process for shaped charged liners is disclosed in the Davison reference. Davison (Ex. 1009). One of the steps disclosed in Davison is to iterate to *converge* on the 'best' design. *Id*. at 4. Petitioner relies on the foregoing language in Davison in its anticipation ground of unpatentability. Pet. 60. In Petitioner's own words:

> Davison describes this process as producing a liner that would produce a deeper hole compared to the baseline conical liner. *Id.* at 7. As such, depth of the hole produced by the improved liner design is closer to that of the desired deep hole. *Id*. at 1. Consequently, the shape produced by the modified liner of Davison "*converges towards*" the desired shape under the meaning of that term in the '039 Patent.

Id. (emphasis added). Evidently, Petitioner has no difficulty in construing and applying the term "converge" when it comes to the Davison reference.

In view of the foregoing, we construe "*converge*" as the product of an iterative design and modelling process that results in a liner design that produces a hole shape that more closely approximates the desired hole shape than the hole shape associated with the known liner design initially selected from the library with respect to one or more hole shape parameters, together with other modified liners, if any, that have been considered during the iterative design process. It is understood that, owing to the irregularity of the shapes of the holes involved, the process of determining convergence may be, at least to some extent, based on qualitative data analysis.

3. All other Claim Terms

Apart from the two claim terms discussed hereinabove (*optimize* and *converge*), Petitioner acknowledges that the remaining terms of the challenged claims may be given their plain and ordinary meaning as understood by a person of ordinary skill in the art. Pet. 30.

VI. SECTION 101 SUBJECT MATTER ELIGIBILITY OF CLAIMS 1–5

An invention is patent-eligible if it claims a "new and useful process, machine, manufacture, or composition of matter." 35 U.S.C. § 101. However, the courts recognize abstract ideas as a judicial exception to Section 101. *Mayo Collaborative Servs. v. Prometheus Labs, Inc.*, 566 U.S. 66, 70–71 (2012). The issue presented in the Petition is whether the challenged claims are directed to an abstract idea. Pet. 34.

The Supreme Court has set forth a framework for distinguishing patents that claim abstract ideas from those that claim patent-eligible applications of the abstract ideas. *Alice Corp. v. CLS Bank Int'l*, 573 U.S. 208, 217 (2014) (citing *Mayo*, 566 U.S. at 72–73). The Supreme Court's framework is a two-step process where, in step one, we determine whether the claims at issue are directed to an abstract idea. *Id.* However, if we determine that the claims are not "directed to" an abstract idea, we resolve the issue at the *Alice/Mayo* step one stage and do not proceed with an analysis under step two. *SRI Int'l, Inc. v. Cisco Systems, Inc.*, 930 F.3d 1295, 1304–04 (Fed. Cir. 2019); *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1337 (Fed. Cir. 2016).

However, if we determine that the claims are directed to patent ineligible subject matter, we proceed to step two, where we "consider the

elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Id.* The Supreme Court characterizes the second step of the analysis as "a search for an 'inventive concept' — i.e., an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself.'" *Alice*, 573 U.S. at 217–18 (brackets in original) (quoting *Mayo*, 566 U.S. at 72).

Petitioner argues claims 1–5 together under this ground of unpatentability. Pet. 33–44. Claim 1 is representative. Petitioner acknowledges that *Alice* governs the analysis under the Section 101 grounds of unpatentability. *Id.* at 33. Petitioner alleges that the claims recite an abstract idea in the form of a mental process. *Id.* at 34. Petitioner alleges that the claims are "directed to" that abstract idea as opposed to being integrated into a "practical application" of that abstract idea. *Id.* at 40–42. Finally, Petitioner alleges that the claims do not recite additional elements that amount to significantly more than the abstract idea. *Id.* at 42–44.

Petitioner asserts that selecting a candidate liner from a library of known liner designs is essentially a mental process that qualifies as an abstract idea. Pet. 35–37. Petitioner also contends that varying designs, modeling the hole shape that a liner produces, and repeating steps in an iterative process are capable of being carried out in the mind of a designer. *Id.* at 38–39. We agree with Petitioner that claim 1 "recites" an abstract idea.

However, we do not assume that all claims that recite abstract ideas are directed to patent ineligible subject matter because "all inventions [at

some level] embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas." *In re TLI Commc'ns LLC Patent Litig.*, 823 F.3d 607, 611 (Fed. Cir. 2016) quoting *Alice*, 573 U.S. at 217. Instead, "the claims are considered in their entirety to ascertain whether their character as a whole is directed to excluded subject matter." *McRO, Inc. v. Bandai Namco Games America Inc.*, 837 F.3d 1299, 1312 (Fed. Cir. 2016). In other words, the "directed to" inquiry applies a stage-one filter to claims, considered in light of the specification, based on whether "their character as a whole is directed to excluded subject matter." *Enfish,* 822 F.3d at 1335. If the claims are not directed to an abstract idea, the inquiry ends. *Id.* at 1339.

In the instant case, Petitioner essentially concedes that the "forming" step goes beyond a mental process. Pet. 41; Tr. 15:3–20 (fabricating). Nevertheless, Petitioner argues that the "forming" step is a mere instruction to apply the mental process. Pet. 41. At the hearing, Petitioner argued that, because it was already known in the art how to form or fabricate a liner, the forming limitation does not allow claim 1 to "get past" Section 101. Tr. 16:5–17:21.

There are at least two problems with Petitioner's argument. The first problem is that we look at claim 1 as a whole and not just the forming limitation. *See McRO,* 837 F.3d at 1312 (explaining that claims are considered in their entirety to ascertain whether their character as a whole is directed to excluded subject matter). Here, the liner is not merely formed, it is formed in accordance with the design process that is outlined in the other steps of the claimed method. The second problem with Petitioner's position is that the subject matter eligibility analysis under section 101 is separate and apart from the novelty and obviousness considerations of sections 102

and 103. *See Bilski v. Kappos*, 561 U.S. 593, 625 (2010) (explaining that the familiar issues of novelty and obviousness are not relevant to a section 101 analysis); *see also Intellectual Ventures I LLC v. Symantec Corp.*, 838 F.3d 1307, 1315 (Fed. Cir. 2016) (explaining that the 'novelty' of any element or steps in a process is of no relevance in determining whether the subject matter of a claim falls within the § 101 categories of possibly patentable subject matter). Thus, Petitioner's argument that forming a liner was known at the time of invention is not relevant to our Section 101 analysis.

Petitioner argues that the forming step does not qualify as integrating the mental process into a practical application because it is not implemented with a particular machine and does not improve a particular technology. *Id.* Petitioner relies on a number of case authorities as standing for the proposition that claims pertaining to data gathering, analysis, and notification on generic computers are directed to abstract ideas at *Alice* step one. *Id.* (citing *Simio, LLC v. FlexSim Software Products, Inc.*, 983 F.3d 1353, 1362 (Fed. Cir. 2020); *Intellectual Ventures*, 838 F.3d at 1318; *In re Killian*, 45 F.4th 1373 (Fed. Cir. 2022); *CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1375, 1372 (Fed. Cir. 2011)).

Contrary to Petitioner's position, the claims, in our opinion, are "directed to" to a method of designing an article of manufacture, namely, a shaped charge liner. The object of the invention is to provide a shaped charge arrangement that facilitates preferential crack formation, growth and orientation in rock strata so as to increase the production efficiency of a working oil well. Ex. 1001, 4:1–3. Figures 4–6 are best understood as depicting representations of actual liners. *Id.* 7:1–2, 8:39 – 9:19, Figs. 4–6.

Figure 10 depicts an apparatus for conducting explosive tests of actual shaped charges. *Id.* 9:55–66, Fig. 10. Fig. 13 shows a photograph of an incursion into rock made by an actual liner. *Id.* 7:16–18, 10:19–25. Thus, although Patent Owner's design process includes aspects of abstract ideas, the claims are not directed to the abstract ideas, rather, they are directed to forming an actual, physical shaped charge liner, which is a practical application of the abstract ideas.

Petitioner's "apply it" argument misses the mark. Almost every article of manufacture is designed and fabricated by means of processes whereby knowledge is "applied" in the design and/or manufacturing process. Even a blacksmith "applies" knowledge in hammering out a horseshoe. As previously mentioned, "all inventions [at some level] embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas." *TLI Commc'ns*, 823 F.3d 607, 611.

Moreover, Petitioner's reliance on *Simio*, *Intellectual Ventures*, *Killian*, and *CyberSource* is misplaced. *Simio* involved computer simulation where the output of the claimed system was realized in the virtual world. *Simio*, 983 F.3d at 1357. *Killian* involved computer software for determining eligibility for social security benefits. *Killian*, 45 F.4th at 1377-78. The output of Killian's system was information. *Id.* *Intellectual Ventures* entailed filtering e-mails. 838 F.3d at 1313. The output in *Intellectual Ventures* was information. *Id.* *CyberSource* involved using computer technology to validate credit card transactions. 654 F.3d at 1368. The output of *CyberSource* was information. *Id.* There is nothing remarkable about Petitioner's cited case authorities. It is well settled that, without additional limitations, "a process that employs mathematical

algorithms to manipulate existing information to generate additional information is not patent eligible." *Digitech Image Techs., LLC v. Elecs. For Imaging, Inc.*, 758 F.3d 1344, 1351 (Fed. Cir. 2014). None of the case authorities relied on by Petitioner is analogous to the claims of the instant case.

Although insignificant extra-solution activity may not cause a claim to be directed to a practical application of an abstract idea (*see Bilski*, 561 U.S. at 610–11), forming an actual, physical, 3-dimensional liner that can be used with an explosive charge to perforate a rock structure can hardly be considered insignificant extra-solution activity that is merely ancillary to performing a mental process. In connection with the method of claim 1, a physical liner is actually formed in a manner determined by the steps of the method. Such a physical liner may be assembled with a charge case and an explosive composition. Ex. 1001, 2:19–24, Fig. 1. The explosive composition may then be initiated to cause the liner material to collapse and be ejected from the charge case in the form of a high velocity jet of material. *Id.* 2:35–38. The jet from the disintegrated liner material may then breach the wall of the perforator gun, the well casing, and then penetrate into a cement layer and rock thereby forming a perforation tunnel. *Id.* 2:38–44. The point here being that forming a liner is an event that takes place in the 3–dimensional physical world. It is not merely an output or display of information. It is something more substantial than mere insignificant extra-solution activity.

In summary, the claims of the '039 Patent are "directed to" forming a shaped charged liner. The forming of such a liner is a practical application of the abstract ideas encompassed by the comparing, selecting, and repeating

steps of claim 1. Because the claims are directed to a practical application of an abstract idea, rather than being directed to the abstract idea itself, we determine that claim 1 recites patent eligible subject matter at the step one phase of *Alice/Mayo* analysis and, therefore, do not reach step two of the analysis. *SRI*, 930 F.3d at 1304–04; *Enfish,* 822 F.3d at 1337.

Accordingly, Petitioner has not shown that claims 1–5 of the '039 Patent are unpatentable under the Section 101 grounds of the Petition.

VII. SECTION 112 GROUNDS OF UNPATENTABILITY

A. Section 112(b) – Indefiniteness of Claims 1–5

A patent is invalid for indefiniteness if its claims, read in light of the specification and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention. *Nautilus,* 572 U.S. at 901. The definiteness provision of Section 112 entails a delicate balance. *Id.* at 909. On the one hand, a patent must be precise enough to afford clear notice of what is claimed, thereby apprising the public of what is still open to them. *Id.* On the other hand, some modicum of uncertainty is considered the price of ensuring the appropriate incentives for innovation. *Id.*

In the instant case, Petitioner asserts that the "optimize" term and the "converge" term render claim 1 indefinite. Pet. 45–50. Much of what we have to say about Petitioner's indefiniteness grounds has already been expressed hereinabove in the claim construction section of this Decision. *See* pp. 6–15 *supra*.

1. Optimize

Petitioner argues that "optimize" cannot possibly mean selecting the best possible liner. Pet. 46. Petitioner then uses this argument as a

springboard to argue that, if optimized means less than the best possible design, a person of ordinary skill in the art would be unable to discern the boundaries of the term because it would depend on the "unpredictable vagaries of any one person's opinion." Pet. 46 (citing *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1371 (Fed. Cir. 2014).

Petitioner further argues that, because the end result of the design process is to produce a liner with an associated hole shape that is "optimized" to the desired hole shape, the liner that is selected during the step of selecting a known liner design from a library, cannot be "optimized" to the desired hole shape, because the liner design has not yet undergone the varying and modelling steps that cause a modified liner design to converge toward the desired hole shape. Pet 46. In other words, if the ultimate purpose of the design process is to yield an "optimized" design, it is seemingly incongruous that such an "optimized" design is selected from the library during the selection step. *Id.*

Neither of Petitioner's arguments is persuasive. In my discussion on claim construction, I was able to construe the claim with the "reasonable certainty" required by *Nautilus*. As previously discussed, I understand why the Examiner rejected claim 1 as indefinite when it recited the term "closest," because, at least according to the Examiner, such amounts to a term of degree and terms of degree require a baseline for comparison. *Liberty Ammunition, Inc. v. United States*, 835 F.3d 1388, 1395 (Fed. Cir. 2016). [5] However, Patent Owner amended claim 1 so as to effectively

[5] I do not necessarily agree with the Examiner on this score. It appears to us that the "desired hole shape" provides the requisite baseline for comparison using a term of degree. *Liberty*, 835 F.3d at 1395. Indeed, the iterative design process is based on the ability to compare one hole shape to another

substitute "optimized" for "closest." Ex. 1002, pp. 35, 41. The Examiner then allowed the claim after this amendment. *Id.* pp. 7, 12. Evidently, the Examiner did not consider "optimized" as a term of degree that required a baseline comparison. Here, Petitioner does not allege that "optimized" is a term of degree.

Petitioner's argument that a person of ordinary skill in the art would be unable to discern the boundaries of the term because it would depend on the "unpredictable vagaries of any one person's opinion" (Pet. 46) is not persuasive. Normal and routine considerations of profit motive and commercial efficiency will ensure that a designer will select a candidate liner that, in his or her professional judgment, is optimized relative to other liners in the library to serve as the starting point for the iterative design process. I do not equate the commercially motivated exercise of professional judgment with the "unpredictable vagaries of any one person's opinion." *Id.* Appellant's indefiniteness argument appears to be calculated to foist upon Patent Owner a degree of mathematical precision that is simply not possible given the current state of the art. However, *Nautilus* admonishes us to give due consideration to the fact that such absolute precision is often unobtainable. *Nautilus,* 572 U.S. at 908–910.

Turning to the question as to whether "optimized," as used in the selection step of claim 1, should be construed as referring to the hole shape that is the ultimate, end result of the design process following the repeated varying and modelling steps, I am mindful that patents are not addressed to lawyers, or even to the public generally, but rather to those skilled in the

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and make a determination as to whether it is converging toward the desired hole shape.

relevant art. *Nautilus,* at 909 (citing *Carnegie Steel Co. v. Cambria Iron Co.*, 185 U.S. 403 (1902)). Therefore, in analyzing indefiniteness, I am aware that "descriptions in patents are not addressed to the public generally, to lawyers or to judges, but, as section 112 says, to those skilled in the art to which the invention pertains or with which it is most nearly connected." *Phillips*, 415 F.3d at 1313 (quoting *In re Nelson*, 280 F.2d 172, 181 (CCPA 1960). The person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification. *Id.* With the foregoing legal standard in mind and taking into account the context in which "optimize" is used in claim 1 in light of the entire disclosure of the specification, there is no danger that a person of ordinary skill in the art would confuse the hole shape that is "optimized" to the desired hole shape in the selection process with the hole shape of the modified liner design that has converged toward the desired hole shape to thereby create a final liner design. Claim 1 recites:

> comparing the desired hole shape to a library of known liner designs, the library including data relating to a hole shape formed by each of the known liner designs within the library;
>
> selecting a liner design from the known liner designs [in a library of known liner designs] that produces a hole shape optimized to the desired hole shape.

Ex. 1001, claim 1. A person of ordinary skill in the art would understand that a selection takes place of a "known liner design" and that such selection takes place with respect to other known liners that are maintained in a library of known liner designs. *Id.* A person of ordinary skill in the art would similarly understand that what is "optimized" in these limitations is the hole shape of a known liner from the library when compared to the "desired hole

shape" and that this takes place during the initial selection process from the library. *Id.* In this way, an optimum (optimized) candidate design is selected from among other known liners in the library for further optimization in accordance with the subsequent varying and modelling steps of the design process.

Thus, there are two principal decisions that are made in the design process of claim 1. The first principal decision is the selection of a known liner design from a library that is made at the beginning of the design process. The second principal decision is made at the conclusion of the design process where a "final liner design" emerges after hole shapes produced by modified liners converge toward the desired hole shape. A person of ordinary skill in the art, having read claim 1 in context, would understand that the term "optimized" in the claim refers to the hole shape of the known liner design that is selected from among the known liner designs in the library during the selection step of the claim. A person of ordinary skill in the art would similarly understand that the design that is chosen in the initial selection process is "optimized" with respect to the population of known liner designs in the library as opposed to being "optimized" relative to liner designs produced during the later varying and modelling steps of the design process.

It appears to me from the context of the Specification that the inventor assigns a consistent meaning to the term "optimize" with regards to both selection of the initial design in claim 1 and how the term is used in the specification with regards to the final design at the conclusion of the design process. Ex 1001, claim 1, 6:7, 7:26, 7:51, 11:42, 12:4, 12:25, 12:58–61. I see no ambiguity, conflict, or inconsistency in the prospect that Patent

Owner uses the same word, "optimize," but in two, somewhat different, contexts. At the beginning of the design process, the hole shape of the design that is initially selected is "optimized" when compared to other, known designs in the library. At the conclusion of the design process, the modified liner design is "optimized" relative to other modified liner designs that have been evaluated during the varying and modelling steps. Ex. 1001, 12:60–63. It is a simple matter of one word, with one meaning, being applied in two different contexts that are clearly and unambiguously identified in the claim.

Thus, claim 1 contemplates consideration of liners with respect to two distinct populations of data. The first data population is the library of known designs. The second data population is the modified designs that are produced in accordance with the varying and modelling steps of the design process and that is not populated with data until after the initial selection is complete. There is no ambiguity or inconsistency in one liner being optimized with respect to the first population of data and a second, modified liner being optimized with respect to the second population of data. Similarly there is no ambiguity or inconsistency is selecting the optimum (optimized) design from among the other candidate liners in the initial selection process and then subjecting that initially "optimized" liner to repeated varying and modelling steps to render the modified liner more optimized to the desired hole shape than the initially selected liner.

Stated differently and more succinctly, an initial design and associated hole shape is selected because it is optimized with respect to other candidate liners in the library and then it is further optimized through the varying and modelling steps to produce a final, more "optimized" liner that has

converged toward the desired hole shape. Ex. 1001, 6:6–22. The passage in column 6 of the specification refers to "selecting the liner design that produces the closest hole shape to the desired hole shape." *Id.* As previously discussed, claim 1 was amended during prosecution to substitute "optimized" for "closest." Ex. 1002, pp. 35–41. A person of ordinary skill in the art would not have interpreted "closest" in column 6, line 14 as referring to the hole shape produced by the final end-product of the design process following the varying and modelling steps. Similarly, a person of ordinary skill in the art would not have interpreted the claim amendment substituting "optimized" for "closest" as anything other than a substantially equivalent expression that was chosen merely to overcome the Examiner's "term of degree" rejection. The requisite degree of certainty required of claim language is "reasonable," not absolute, certainty. *Nautilus,* 572 U.S. at 908–910. Petitioner's construction that "optimized" may refer to the final end product of the design process before any of the varying and modelling steps have been undertaken, is simply not reasonable.

In agreeing with the Petitioner, the Dissent goes astray by artificially restricting use of the term "optimized" so that it can only be applied to the final liner design that is produced at the conclusion of the varying, modelling, and convergence. Petitioner and the Dissent fail to properly consider the context in which the term is used. They fail to properly consider that the hole shape produced by Liner "A" may be optimized in relation to a library of known liner designs and that modified Liner "B" may be optimized in relation to a population of other modified liners that have been produced during varying and modelling steps of the design process. Common usage of the English language dictates that many different things

can be optimized and, more particularly, different things can be optimized with respect to various and diverse data populations to which such things may be compared. There is no reason that, just because the term "optimize" is used in the specification of the '039 Patent in relation to the final, converged design, such term cannot also be used in a different context, such as during the selection step of claim 1 for the candidate liner. "There is no requirement that the words in the claim must match those used in the specification disclosure." *In re Skvorecz*, 580 F.3d 1262, 1268-69 (Fed. Cir. 2009); MPEP 2173.05(e).

"Optimize" is regularly used in the industry literature on perforation tunnel formation. Ex. 1007, pp. 1–5; Ex. 1010, 1:1, 3:26–37, 12:51. I further note that using the term "optimize" with respect to selecting a design is not fundamentally different than, for example, Davison referring to testing the "most promising designs." Ex. 1009, p. 4. Thus, although the term "optimized" does allow for some modicum of uncertainty, such is necessarily due to the inherent difficulties in comparing the shapes of irregular holes formed in rock by explosive charges. *Nautilus,* 572 U.S. at 901.

Petitioner presents testimony from Mr. Serra on the alleged indefiniteness of optimized. Ex. 1003 ¶¶ 69–79. Indefiniteness is a question of law. *Teva Pharma. USA, Inc. v. Sandoz, Inc.*, 789 F.3d 1335, 1342 (Fed. Cir. 2015). Thus, Mr. Serra's testimony cannot be used to prove the proper or legal construction of an instrument of writing. *Teva*, 574 U.S. at 332. Furthermore, Mr. Serra's indefiniteness analysis fails to account for how the term optimized is used in the industry literature. Ex. 1003 ¶¶ 69–79. His testimony on indefiniteness is belied by his testimony on prior art grounds of

unpatentability. He appears to have no difficulty in understanding the meaning of the term when used in prior art references in a similar context. *See e.g.*, Ex. 1003 ¶¶ 102, 119, 122, 149, 163. Mr. Serra's testimony is given little weight in my analysis. *Homeland Housewares, LLC v. Whirlpool Corp.*, 865 F.3d 1372, 1378 (Fed. Cir. 2017) (explaining that we should disregard expert testimony that is plainly inconsistent with the record or based on an incorrect understanding of the claims).

Petitioner fails to demonstrate that claims 1–5 are unpatentable as indefinite on account of its use of the term optimize.

2. Converge

Many of the legal principles discussed above with respect to the "optimize" term apply with equal force to the "converge" term. Both terms involve comparing one irregularly shaped perforation tunnel to another. Both terms encounter similar difficulties in making such comparisons. Nevertheless, as with the "optimize" term, we were able to construe the "converge" term (*see* pp. 13–15 *supra*) with the "reasonable certainty" required by *Nautilus*.

Moreover, having reviewed Patent Owner's Specification and the prior art, it appears that a skilled designer is fully capable of comparing two known perforation tunnel shapes to a desired tunnel shape and coming to a reasoned judgment that one is more similar than the other as to one or more parameters of a desired hole shape. Such is the underlying premise behind the selecting step in claim 1. Such is also the underlying premise in the repeating and varying step in claim 1. After varying and modelling, a modified liner in the sequence of iterative repeating steps will either be more similar or less similar than that of a previous iteration with respect to one or

more hole parameters of interest. If it is more similar, it may be considered to "converge" toward the desired hole shape. Indeed, it is the ability of a professional shape charge designer to perform such comparison that is at the heart of virtually all of the prior art that Petitioner cites in its various challenges to Patent Owner's claims.

Petitioner's indefiniteness case is severely undercut by its anticipation ground of unpatentability over the Davison reference. Pet. 54–60. Davison uses the term "converge" in a manner substantially similar to that of claim 1. Ex. 1009, p. 4. Petitioner and its expert encounter no difficulty in understanding the term "converge" as it is used in Davison. Pet. 60, Tr. 14:18–24; Ex. 1003 ¶¶ 100, 104, 108. In our opinion, a person of ordinary skill in the art would similarly have no difficulty in understanding and applying the term as it is used in Patent Owner's invention.

Petitioner fails to demonstrate that claims 1–5 are unpatentable as indefinite on account of its use of the term converge.

B. Section 112(a) – Non-Enablement of Claims 1–5

Petitioner's non-enablement grounds is largely derivative of its indefiniteness grounds. Pet. 50–53. In essence, Petitioner points to the alleged lack of mathematical certainty over the meaning of the "optimize" and "converge" terms of claim 1 and then relies on such alleged mathematical uncertainty to argue that the '039 Patent fails to instruct a skilled practitioner how to make and use the invention. *Id.*

Enablement is a legal determination of whether a patent enables one skilled in the art to make and use the claimed invention. *Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1384 (Fed. Cir. 1986). To be enabling, a patent's specification must "teach those skilled in the art how to

make and use the full scope of the claimed invention without 'undue experimentation.'" *ALZA Corp. v. Andrx Pharm., LLC*, 603 F.3d 935, 940 (Fed. Cir. 2010). However, a patent need not teach, and preferably omits, what is well known in the art. *Streck, Inc. v. Research & Diagnostic Sys., Inc.*, 665 F.3d 1269, 1288 (Fed. Cir. 2012). Thus, an inventor need not explain every detail since he is speaking to those skilled in the art such that what amounts to conventional knowledge will be read into the disclosure. *In re Howarth*, 654 F.2d 103, 105 (CCPA 1981).

The issue here is relatively simple and straightforward. Namely, is a skilled practitioner able to analyze and evaluate the size and shape of two or more perforation tunnels and make a reasoned determination that one tunnel is more similar to a desired tunnel shape than another with respect to one or more parameters. If the answer to that question is yes (and it is), then a skilled practitioner is capable of: (1) selecting a candidate liner for a starting point of an iterative design process; and (2) determining if a modified liner produces a tunnel that converges toward the desired tunnel shape.

Petitioner's non-enablement grounds seeks to foist upon Patent Owner an artificial and arbitrary standard of mathematical precision and certainty that does not appear to be feasible given the current state of the art. Petitioner's non-enablement contentions are belied by the positions taken in its prior art grounds of unpatentability. In its prior art grounds, Petitioner essentially argues that the claimed subject matter is so obvious that a person of ordinary skill in the art could make and use the claimed invention without even needing Patent Owner's disclosure. During the hearing, Petitioner's counsel all but abandoned the non-enablement grounds of unpatentability. Tr. 18:11–19:3.

Patent Owner's design process contemplates that a skilled practitioner can compare two or more perforation tunnels and determine which one is more similar to a desired tunnel. This allows the practitioner to, first of all, select a candidate liner for the start of the design process and, secondly, determine whether a modified liner produces a perforation tunnel that converges toward a desired hole shape. It is understood that, in the current state of the art, such process is not carried out to a degree of mathematical certainty. The qualitative nature of this decision making process is reflected in prior art references such as Davison when it refers to "test the most promising designs" and "iterate to converge on the 'best' design." Ex. 1009, p. 4.

In view of the foregoing discussion, it is our opinion that Petitioner has failed to demonstrate that claims 1–5 are unpatentable as non-enabled.

C. Section 112(a) - Written Description – Claim 1–5

Petitioner's written description ground of unpatentability is two paragraphs in length and is largely derivative of the indefiniteness and non-enablement grounds previously discussed. Pet. 53–54. Petitioner's written description ground focuses on the "optimized" term of claim 1. *Id.* Petitioner alleges that "optimized" was added to claim 1 by amendment and that the Specification fails to provide any support for the "new" term. *Id.* at 53.

To satisfy the written description requirement, a patent's specification must "reasonably convey[ ] to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc). Disclosure is essential as it is "the quid pro quo of the right to

exclude." *Novartis Pharmaceuticals Corporation v. Accord Healthcare, Inc.*, 38 F.4th 1013, 1016 (Fed. Cir. 2022).

Patent Owner's Specification discloses a method of optimizing a shaped charge liner design for use in an oil/gas well perforator in order to form a desired hole shape in a rock formation. Ex. 1001, 6:6–9. The method includes comparing a desired hole shape to a library of known liner designs where the library contains data relating to the hole shape formed by each liner design within the library. *Id.* at 6:11–13. The designer then selects a liner design that produces a hole shape that is closest to a desired hole shape. *Id.* at 6:14–15, 11:49–12:44.

We have previously discussed the circumstances under which Patent Owner amended claim 1 to essentially substitute the word "optimized" for "closest" during prosecution. Patent Owner's teaching regarding selecting a liner that produces the "closest" hole shape to a desired hole shape provides written description support for selecting a liner design that produces a hole shape "optimized" to the desired hole shape. With full awareness of potential Section 112 problems, the Examiner allowed Patent Owner's amendment substituting "optimized" for "closest" without raising a written description rejection. It is well settled that a claimed invention does not have to be described in *ipsis verbis* in the specification to satisfy the written description requirement. *Union Oil Co. of Cal. v. Atl. Richfield Co.*, 208 F.3d 989, 1000 (Fed. Cir. 2000).

In using the term "closest" in the specification, Patent Owner demonstrates possession of an iterative design process that entails selection of an appropriate, i.e., "optimized" candidate liner design as the starting point for the process. Petitioner fails to demonstrate, by a preponderance of

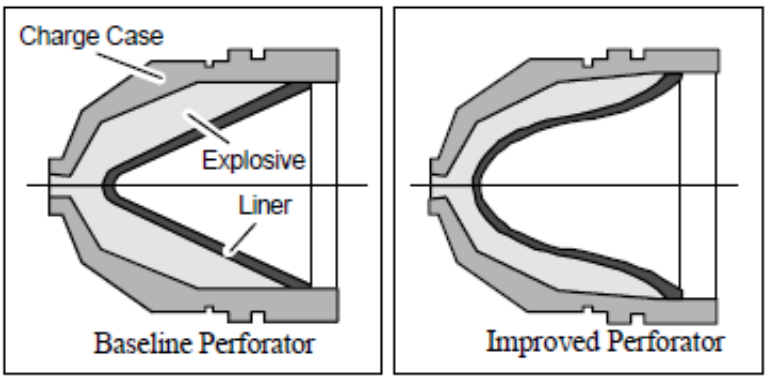
the evidence, that claims 1–5 are unpatentable as lacking written description support.

VIII. ANTICIPATION BY DAVISON

To anticipate a claim, a prior art reference must disclose every limitation of the claimed invention, either expressly or inherently. *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1341 (Fed. Cir. 2016). Furthermore, it must disclose all of the limitations of the claim, "arranged or combined in the same way as in the claim." *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1370 (Fed. Cir. 2008).

1. Davison

Davison is an article entitled *Hydrocode-Designed Well Perforator With Exceptional Performance* published by the 17th International Symposium on Ballistics, in Midrand, South Africa, in March of 1998. Davison is directed to increasing the jet energy and penetration of shaped charges. Ex. 1009, p. 1. Figure 3 of Davison is reproduced below:



DAVISON – FIGURE 3

Figure 3 of Davison depicts a baseline perforator that features a conical liner juxtaposed to an improved perforator that features a bell-shaped liner of variable thickness. *Id.* at 3. Davison alludes to its bell-shaped liner

as being similar to ones that have shown performance gains in "prior studies." *Id.* at 1.

According to Davison, perforations created by the baseline design tapered to a small diameter, while those created by the improved design were deeper and did not taper to a small diameter. *Id.* at 4. Davison reports that the improved design is more effective in bringing hydrocarbons to the wellbore. *Id.*

2. Davison – the individual claim elements

Petitioner alleges that Davison discloses each limitation of claim 1. Pet. 54–61. We disagree. We analyze the limitations that are dispositive of this ground of anticipation below.

a. library of known liner designs

Petitioner alleges that the limitation directed to comparing a desired hole shape to a library is satisfied by Davison's disclosure of "prior studies." *Id.* p. 56 (citing Davison p.1). Petitioner alleges that Davison's "prior studies" should be understood as referring to a "library, including data relating to a hole shape formed by each of the known liner designs within the library" within the meaning of claim 1. *Id.;* Serra (Ex. 1003) ¶¶ 98-99. Petitioner interprets "library" to include the "common knowledge" of a person of ordinary skill in the art. Tr., 25:15. Mr. Serra testifies that a "library" can include both formally recorded knowledge as well as the know-how and experience that a designer has mentally memorized but not formally recorded. Ex. 1003 ¶ 54. We have reviewed Davison and it does not appear to contain any explicit disclosure as to whether, where, or how the "prior studies" are memorialized and/or compiled into an identifiable "library."

Determining whether claims are anticipated under Section 102 involves a two-step analysis. *In re Montgomery*, 677 F.3d 1375, 1379 (Fed. Cir. 2012). The first step involves construction of the claims of the patent at issue. *Id.* The second step of an anticipation analysis involves comparing the claims to the prior art. *Id.* A person of ordinary skill in the art would understand a "library" to be a repository of literature or similar information that is maintained on some form of tangible medium such as paper, magnetic tape, film, or some form of computer readable media. The context in which the term "library" appears in the claim requires that the library associate each liner design with a corresponding hole shape that is formed by each such liner design. Ex. 1001, 13:6–9. *See Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1062 (Fed. Cir. 2016) (discussing the importance of construing claim terms in the context in which those terms appear). A library is also understood to have identifiable boundaries of some kind that would tend to differentiate between literature/information that is "inside" of the library as opposed to literature/information that is "outside" of the library. The '039 Patent furnishes its own description of a library and a process for generating such a library. Ex. 1001, 11:37–12:41. In the context of claim 1, associating each liner with a corresponding hole shape and reposing such information "inside" a library with identifiable boundaries is critical to the selecting step of the claimed method. *Id.* 12:42–45. Without such identifiable boundaries, a person of ordinary skill in the art would be unable to determine whether a library had been completely or thoroughly searched.

Davison's vague allusion to "prior studies" falls short of disclosing a library of known designs. The mere fact that, at various places and various times, practitioners may have tested bell-shaped liners of variable thickness

and noted performance gains over conical liners, does not establish that the results of such "prior studies" have been accumulated, organized, and reposed in a "library" with identifiable boundaries as to be available for selection in an iterative design process such as claim 1 of the '039 Patent. In contrast to the description of generating a library in the '039 Patent (Ex. 1001, 11:37 – 12:41), there is no analogous, explicit disclosure in Davison that such a library is created. Furthermore, Petitioner presents no evidence that such a library should be considered as inherently created by the so-called "prior studies." Pet. 56–57.

At the hearing, Petitioner's counsel offered that an in-house engineer in the art "would have necessarily had a library of prior designs and knowledge." Tr. 7:20–25. However, such gratuitous statements do not rise to the level of evidence. *See Estee Lauder, Inc. v. L'Oreal, S.A.*, 129 F.3d 588, 595 (Fed. Cir. 1997) (explaining that attorney argument cannot take the place of evidence in the record); *see also Invitrogen Corp. v. Clontech Labs, Inc.*, 429 F.3d 1052, 1068 (Fed. Cir. 2005) (unsubstantiated attorney argument is no substitute for competent evidence). Furthermore, we do not credit Mr. Serra's testimony that a library includes information that has been "mentally memorized but not formally recorded." Ex. 1003, ¶ 54. It is well settled that anticipation requires disclosure of all claim elements within the four corners of the reference. *Net MoneyIN,* 545 F.3d at 1369 (citing *Xerox Corp. v. 3Com Corp.*, 458 F.3d 1310, 1322 (Fed. Cir. 2006). Mr. Serra's reliance on "mentally memorized" information that is not recorded in an anticipation reference demonstrates an unfamiliarity with the law of anticipation. Petitioner's invocation of common knowledge that may have been known to the skilled practitioner is outside of the four

corners of Davison and cannot be used to fill in gaps in Davison's disclosure.

Petitioner advances an alternative theory of creation and use of a library and supports this alternative theory with testimony from Mr. Serra. Pet. 57, Serra (Ex. 1003) ¶ 100. This alternative theory focuses on the shaped charge design approach paragraph beneath Figure 5 on page 4 of Davison. *Id.* Under this theory, a "library" is created in steps (1) and (2) of the design approach. *Id.* Davison describes its design approach in the following terms:

> (1) Compute the perforator jetting with the definitive AUTODYN 2D program;
>
> (2) Compute the hole shape using the analytical penetration theory;
>
> (3) Derive liners that give jets of maximum energy and holes of maximum size;
>
> (4) Test the most promising designs; and
>
> (5) Iterate to converge on the "best" design(s).

Davison (Ex. 1009), p. 4. However, there is no indication that the liner for which perforator jetting was computed in step (1) was selected from a library of known liner designs. Furthermore, there is no indication that the hole shape that is computed in step (2) is based on a liner that was selected from a library. Finally, even if a "library" is created by steps (1) and (2) above (there is not), there is no disclosure of then selecting an "optimized" liner out of such (non-existent) library.

b. selecting – optimized to desired hole shape

Petitioner alleges that Davison replaces a conical liner with a bell-shaped liner based on gains in performance achieved by bell-shaped liners in "prior studies." Pet. 57. Petitioner alleges that such corresponds to the

Patent Owner's claim limitation directed to selecting a liner design. *Id.* Petitioner glosses over important distinctions between Davison and the '039 Patent.

There are several aspects to this claim limitation, some of which are not addressed in the Petition. The first aspect is selecting a liner design from the library recited in the preceding limitation. The second aspect is comparing the hole shape produced by a candidate liner design to a "desired" hole shape. The third aspect is making a selection based on the comparison that optimizes the relationship between the candidate hole shape and the desired hole shape.

Davison is concerned with creating a "smooth, well-rounded hole through the casing as well as a deep, uniform hole in the concrete." Ex. 1009, p. 1. Davison reports test result data comparing a baseline, conical perforator and a bell-shaped, improved perforator. *Id.* at 3. The only parameters on which data is reported is: (1) entry hole diameter, (2) diameter of hole at bottom, and (3) total target penetration. *Id.* Davison's five-step shaped charge design approach is focused to give jets of maximum energy and holes of "maximum size." There is no mention of any other attributes of the shape of a hole.

In contrast, the '039 Patent is concerned with multiple facets of the shape of a perforation tunnel. For example, Figure 9A depicts a perforation tunnel with rectilinear geometry with a hole through the well casing that is "slot" shaped. Ex. 1001, 9:34–39, Fig. 9A. Figure 9B depicts a perforation tunnel that is generally "Y" shaped. *Id.* 9:40–46, Fig. 9B. The tunnel in Figure 9C is diamond shaped. *Id.* at 9:48–49, Fig. 9C. The tunnel in Figure 9D is generally elliptically shaped. *Id.* at 9:50–51, Fig. 9D. A person

of ordinary skill in the art having read the Specification and the claims of the '039 Patent, in context, would understand the ordinary and customary meaning of "desired hole shape" to include attributes other than just size.

Contrary to Petitioner's allegations, Davison's disclosure of "prior studies" does not amount to disclosure of a "library" as claimed and, therefore, cannot and does not disclose selecting a liner design from a (non-existent) library. It follows, therefore, that there is also no comparison and optimization determination in the selection process.

Moreover, even under Petitioner's alternative library theory, there is no indication that the liner used in steps (1) and (2) was selected by comparing liner data that had been compiled in a library of known liner designs and where the liner that was selected for computation was optimized to a desired hole shape. *See* Davison (Ex. 1009), p. 4. Again, even if a "library" is created by steps (1) and (2) above (there is not), there is no disclosure of then selecting an "optimized" liner out of such (non-existent) library for purposes of engaging in varying and modelling steps.

c. the varying, modelling, repeating, and forming limitations

We recognize that there are superficial similarities between Davison and claim 1. Nevertheless, it is not clear to us from our review of Davison how the varying, modelling, repeating, and forming limitations of claim 1 map onto Davison. Further in that regard, the Petition itself is less than a model of clarity on the subject and appears to obfuscate differences between Davison and the '039 Patent when it comes to computer modelling as opposed to physical testing of prototypes in the design process. It appears to us that Davison begins with a baseline, conical liner with a linear (tapered) thickness profile and then modifies it to have a bell shape with a variable

thickness profile. Davison (Ex. 1009) p. 2. It then appears that one or more baseline and one or more improved perforators were test fired against physical, concrete targets. *Id.* pp. 1–3. It is not clear how much, if any and in what sequence, of Davison's iterative design process relies on modelling as claimed in the '039 Patent as opposed to explosive, physical testing of actual shaped charge prototypes into rock and/or concrete targets.

In view of the foregoing discussion, it is our determination that Petitioner fails to establish, by a preponderance of the evidence, that Davison anticipates claim 1 of the '039 Patent.

3. Anticipation of Claims 2 and 3 by Davison

Claims 2–5 of the '039 Patent are not anticipated by Davison for at least the same reasons as claim 1. There are also additional reasons that there is no anticipation of claims 4 and 5.

4. Anticipation of Claim 4 by Davison

Claim 4 depends from claim 1 and adds the limitation: "wherein the varying step comprises varying a liner material for the selected liner design." Ex. 1001, 13:30–32. Petitioner alleges that this limitation is met by Davison. Pet. 64–65. Petitioner cites to Davison as disclosing a liner made from tungsten and copper. *Id.* at 64 (citing Ex. 1009, p. 5). Petitioner cites testimony from Mr. Serra to the effect that, because Davison teaches that liners can be made from "powdered metal," such amounts to a teaching that liners can be made from many different materials. *Id.* at 64 (citing to Serra, Ex. 1003 ¶ 116). Petitioner also introduces testimony from Mr. Serra that, because a liner can be made from tungsten and copper that "many different types of liners can be made from these materials." *Id.* at 64–65 (citing Serra, Ex. 1003 ¶ 116.

We have reviewed Davison. Davison makes a single reference to liners being pressed from a first material comprised of powdered metal, primarily tungsten and copper. Davison (Ex. 1009) p. 5. There is no disclosure in Davison that any liner was prepared with a second and different liner material. Mr. Serra's testimony that liners "can be made" from many different materials is not sufficient to establish that the claim limitation is met by the four corners of Davison. *Net MoneyIN,* 545 F.3d at 1369.

Thus, in addition to the deficiencies noted with respect to Petitioner's challenge to claim 1, from which claim 4 depends, Petitioner has also not shown, by a preponderance of the evidence, that the dependent limitation of claim 4 directed to liner material is met by Davison.

5. Anticipation of Claim 5 by Davison

Claim 5 depends from claim 1 and adds the limitation:

> wherein the data for the plurality of liner designs includes the hole shape of each of the plurality of liner designs produces in a range of different rock strata, the method further comprising filtering the data for the plurality of liner designs against rock conditions for a particular well environment.

Ex. 1001, 13:33–38.

We have reviewed the allegations and evidence offered by Petitioner as to claim 5. Pet. 65–66. Petitioner's case builds on the allegations from its challenge to claim 1 that Davison discloses a library as claimed. *Id.* We have previously determined that Petitioner's challenge to claim 1 is deficient as to the library elements. As there is no library explicitly disclosed in Davison, it follows that there is no library that cross-references liners and their corresponding hole shapes with differing rock lithologies. To the extent that Petitioner cites evidence that Davison mentions different types of

rock, it is not related to a library that correlates data on liners, and corresponding hole shapes filtered for differing types of rock.

Thus, in addition to the deficiencies noted with respect to Petitioner's challenge to claim 1, from which claim 5 depends, Petitioner has also not shown, by a preponderance of the evidence, that the dependent limitation of claim 5 directed to hole shapes produced in a range of different rock strata is met by Davison.

IX. UNPATENTABILITY OF OVER COMBINATIONS BASED ON DAVISON

Petitioner asserts that claims 2–4 are unpatentable over the combination of Davison and Quattlebaum (Ex. 1007), that claims 2–4 are unpatentable over the combination of Davison and Walters (Ex. 1014), and that claim 5 is unpatentable over Davison and Smith (Ex. 1015).

A patent is invalid for obviousness:

> if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

35 U.S.C. § 103. Obviousness is a question of law with underlying factual findings relating to the level of ordinary skill in the pertinent art; the scope and content of the prior art; differences between the prior art and the claims at issue; the presence or absence of a motivation to combine or modify prior art with a reasonable expectation of success; and any objective indicia of non-obviousness. *Persion Pharms. LLC v. Alvogen Malta Operations Ltd.*, 945 F.3d 1184, 1189 (Fed. Cir. 2019); *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Courts must consider all four *Graham* factors prior to

reaching a conclusion regarding obviousness. *See Eurand, Inc. v. Mylan Pharms., Inc*. (*In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig*.), 676 F.3d 1063, 1076–77 (Fed. Cir. 2012). However, in the instant case, Petitioner raises no factual issues with respect to the fourth *Graham* factor of objective indicia of non-obviousness. Pet. 93–94. We will, therefore, base our unpatentability determination on the first three *Graham* factors.

As the party challenging the patentability of the claims at issue, Petitioner bears the burden of proving obviousness by a preponderance of the evidence. *See* 35 U.S.C. § 316(e).

A. Level of Ordinary Skill

Petitioner's expert, Mr. Serra testifies that he is familiar with the level of a person of ordinary skill in the art at the time of the invention. Ex. 1003 ¶ 10. He further testifies that a person of ordinary skill would have had a B.S. degree in in Physics or Mechanical or Petroleum Engineering, as well as two or more years of experience related to shaped charges for oil and gas applications. *Id.* ¶¶ 44–45. According to Mr. Serra, such a person would have been familiar with the process of well completion, with some knowledge of the general approach for hydraulic fracturing and also would have been generally familiar with a process of varying parameters and comparing the results to desired outcomes. *Id.* ¶ 45.

The level of skill in the art often can be determined from a review of the prior art. *See Litton Indus. Products, Inc. v. Solid State Sys. Corp*., 755 F.2d 158, 163–64 (Fed. Cir. 1985). Mr. Serra's opinion on the level of the ordinary skill art is consistent with what we would expect from an ordinary practitioner that is capable practicing the prior art. We agree that a person of

ordinary skill in the art who could practice the teachings of, for example, the Guinot reference (Ex. 1010), would have the skill level described by Mr. Serra. Accordingly, we adopt Petitioner's stated skill level for the purpose of our obviousness analysis.

B. Scope and Content of the Prior Art

A reference qualifies as prior art for an obviousness determination when it is analogous to the claimed invention. *Innovention Toys, LLC. v. MGA Ent., Inc.*, 637 F.3d 1314, 1321 (Fed. Cir. 2011). All of Petitioner's cited references come from the same field of endeavor as the '039 Patent and, therefore, are considered to fall within the scope and content of the prior art for an obviousness analysis.

1. Davison (Exhibit 1009)

Davison has been discussed under the anticipation grounds in the preceding section of this Decision and will not be repeated here.

2. Quattlebaum (Exhibit 1007)

Quattlebaum is a paper published by the Society of Petroleum Engineers entitled *Optimizing Perforating Charge Design for Stimulation.* Quattlebaum discusses the trade-offs between using "big hole" (BH) as opposed to "deep penetrating" (DP) charges. Exhibit 1007, p. 6.

> BH charges typically use a parabolic shaped solid metal liner, whereas DP charges most commonly have a liner pressed from powdered metal particles into a convex shaped liner. As their names suggest, the performance of each class of charge is unique. Under a given set of conditions, a correlative trade-off exists between the penetration of a charge and the casing hole size that it creates. In other words, as the penetration becomes greater, the casing hole size becomes smaller; conversely, as the hole size created becomes larger, the depth of penetration becomes smaller.

Id. Consistent with other industry literature, Quattlebaum teaches that shaped charges have three basic components, namely: (1) a charge case; (2) an explosive load; and (3) a liner. *Id.* at 7. Quattlebaum teaches that the performance of a shaped charge or gun system is varied through modifying the geometry, quantity, or composition of those main components. *Id.* at 7–8. Quattlebaum also teaches that variation of the components "can be optimized" for a given set of conditions including optimizing hole size and hole size consistency. *Id.* at 8. Quattlebaum developed a shaped charge jet perforator to minimize the variation in hole size. *Id.* One of the conclusions of Quattlebaum's study is that shaped charge jet perforators can be optimized for a given set of conditions. *Id.* at 12.

3. Walters (Ex. 1014)

Walters is a treatise entitled *Fundamentals of Shaped Charges*. Ex. 1014. Petitioner's Walters exhibit is comprised of an excerpt of 77 pages selected from the larger work. *Id.*

4. Smith (Ex. 1015)

Smith is a paper published by the Society of Petroleum Engineers entitled *Improvements in Perforating Performance in High Compressive Strength Rocks*. Ex. 1015. Smith explains that the performance of shaped charges is significantly affected by the compressive strength of the rock to be perforated. *Id.* at 1. Smith explains that rock lithology is a recognized variable affecting rock penetration by a perforation charge. *Id.* at 2. Smith further explains that a charge may be optimized starting with a combination of computational, analytical and instrumented tests that are used to understand, first, the physics of jet formation and, second, the jet/target interaction. *Id.* at 3. The Autodyn™ finite difference code is used to

calculate the jet velocity and mass versus time/position. *Id.* Penetration time of arrival tests are then conducted to obtain jet quality and dynamic target properties. *Id.* Such test results are then used in an analytical penetration code. *Id.* Finally, X-rays of the jet versus target penetration are used to help determine the active target effect which is then used to update the penetration model. *Id.* Design iterations are then performed to obtain an optimum design. *Id.*

C. Differences Between the Prior Art and the Claimed Invention

1. Davison (Ex. 1009)

The differences between the Davison reference and the claimed invention have previously been discussed in the preceding section of this Decision relating to anticipation by Davison and will not be repeated here. For the most part, in its obviousness analysis over combinations based on Davison, Petitioner does not acknowledge any of the differences between Davison and the claimed invention that we have noted previously with respect to claim 1. Petitioner does not propose to modify Davison, for purposes of an obviousness analysis, apart from combining it with the explicit teachings of other references.

2. Quattlebaum (Ex. 1007)

With respect to claim 2, Petitioner relies on Quattlebaum as teaching varying the thickness of a shape charge liner in the design process. Pet. 68 (citing Ex. 1007 pp. 6–8). With respect to claim 3, Petitioner relies on Quattlebaum as teaching varying the apex angle of a liner during the design process. Pet. 69 (citing Ex. 1007 pp. 6–8). With respect to claim 4, Petitioner relies on Quattlebaum as disclosing that jet perforator

performance can vary depending on the particular materials in the charge case and liner. Pet. 69 (citing Ex. 1007 pp. 6–8).

The Petition makes no effort to map the various limitations of claim 1 of the '039 Patent onto Quattlebaum. *See* Pet. 67–70. We have not independently scoured Quattlebaum with a view to augmenting the Petition with factual findings that are not, in the first instance, pointed out in the Petition. Petitioner shoulders the burden to point out evidence supporting its position with "particularity." 35 U.S.C. § 322(a)(3); *cf.* *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359 (Fed. Cir. 2016) ("It is of the utmost importance that petitioners in the IPR proceedings adhere to the requirement that the initial petition identify 'with particularity' the 'evidence that supports the grounds for the challenge to each claim.") (citing the analogous 35 U.S.C. § 312(a)(3)). Thus, Petitioner presents no evidence from Quattlebaum that tends to cure the deficiencies we have previously noted under the anticipation grounds of claim 1.

3. Walters (Ex. 1014)

With respect to claim 2, Petitioner relies on Walters as teaching varying the thickness of a shape charge liner. Pet. 71–72 (citing Ex. 1014 pp. 45, 334). With respect to claim 3, Petitioner relies on Walters as teaching varying the apex angle of a liner. Pet. 73 (citing Ex. 1014 pp. 334–39). With respect to claim 4, Petitioner relies on Walters as disclosing that jet perforator performance can vary depending on the particular materials in the charge case and liner. Pet. 74–75 (citing Ex. 1014 pp. 343, 352, 381).

The Petition makes no effort to map the various limitations of claim 1 of the '039 Patent onto Walters. *See* Pet. 70–75. Petitioner presents no

evidence from Walters that tends to cure the deficiencies we have previously noted under the anticipation grounds of claim 1.

4. Smith (Ex. 1015)

With respect to claim 5, Petitioner relies on Smith for describing studies that evaluate the performance of shaped charge liners for different types of rock. Pet. 76 (citing Ex. 1015, p. 2). Petitioner alleges that Smith, by evaluating the performance of shaped charges in different types of rock, discloses creation of a library containing such information. Pet. 77 (citing Ex. 1015, p. 2).

Petitioner also alleges that Smith teaches "filtering" of a library of data regarding known liners against rock conditions for a particular well environment. Pet 77 (citing Ex. 1015, pp. 1–2). Petitioner alleges that Smith teaches storing known liner designs based on the compressive strength of targets into which those liners were shot. Pet. 77 (citing Ex. 1015, p. 6). Petitioner alleges that Smith necessarily filters data based on rock type "because it would not be possible to reach these conclusions without at least some filtering of the data based on rock type." Pet. 78 (citing Serra declaration, Ex. 1003 ¶ 156). Petitioner concludes that it would have been obvious to modify Davison to include filtering a library of liner design data against rock conditions for a particular well environment. According to the Petitioner, a person of ordinary skill in the art would have done this to better optimize the liner design for the rock strata to be mined. Pet. 78 (citing Serra decl. Ex. 1003 ¶ 157).

Smith discloses testing shaped charge penetration where an optimized design was restricted to a liner geometry change. Smith (Ex. 1015) p. 3. We have reviewed page 2 of Smith which is relied on by Petitioner as compiling

a library of data regarding rock strata. In our opinion, Smith does not disclose what is required by claim 5. Claim 5 requires that the library of known liner designs of claim 1, in addition to correlating data of the liner parameters with data as to the hole shapes produced thereby, also correlates the data of the liner design parameters with the hole shapes produced thereby and further correlates with data of hole shapes produced in different rock strata. Ex. 1001, 13:2–12, 13:33–36. Although we agree that Smith is concerned with perforating performance in various different types of rock, we see no teaching or suggestion that such data is compiled in a library that correlates liner design parameters with hole shape. Furthermore, we see no teaching or suggestion that a liner design is selected as the starting point for an iterative design process based on it being optimized to a desired hole shape as required by claim 1.

The Petition makes no effort to map the various limitations of claim 1 of the '039 Patent onto Smith. *See* Pet. 76–78. Petitioner presents no evidence from Smith that tends to cure the deficiencies we have previously noted under the anticipation grounds of claim 1. In short, Davison does not disclose a "library" as claimed. Consequently, the combined teachings of Davison and Smith fail to disclose a library where correlated liner design and hole shape data is augmented to include hole shapes that are correlated with rock type data. Moreover, since the correlated data is not reposed in a library, the combination also does not teach or suggest a method where library data is filtered according to rock type.

D. Ultimate Conclusion of Obviousness

After considering all of the underlying factual considerations, the ultimate conclusion of obviousness is a question of law. *Pfizer, Inc. v.*

Apotex, Inc., 480 F.3d 1348, 1359 (Fed. Cir. 2007). With respect to each of the three proposed combinations of prior references, namely: Davison and Quattlebaum; Davison and Walters; and Davison and Smith, we note significant holes in Petitioner's evidentiary submission as to each of the claim limitations with respect to each combination of references and each challenged claim. Ordinarily, we note that a claimed invention may be obvious even when the prior art does not teach each claim limitation. *Beckson Marine, Inc. v. NFM, Inc.*, 292 F.3d 718, 728 (Fed. Cir. 2002). However, such circumstance is generally limited to situations where the record otherwise contains some reason that would cause one of skill in the art to modify the prior art to obtain the claimed invention. *Id.* In an obviousness analysis, "we do not ignore the modifications that one skilled in the art would make to a device borrowed from the prior art." *In re Icon Health & Fitness, Inc.*, 496 F.3d 1374, 1382 (Fed. Cir. 2007). This, of course, is predicated on the assumption that the necessary modification would have taken no more than ordinary skill. Skill in the art does not act as a bridge over gaps in the substantive presentation of an obviousness case. *Ryko Mfg. Co. v. Nu–Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991).

In the instant case, we are not only confronted with gaps in Petitioner's evidentiary presentation in mapping the claim elements onto the prior art, we also note almost a complete absence of an evidentiary presentation as to how or why gaps in the prior art would have been overcome through the exercise of ordinary skill. Further in that regard, we note almost a complete absence of evidence or persuasive technical reasoning as to why a person of ordinary skill in the art would have been motivated to modify the prior art to fill in the aforementioned gaps to

achieve the claimed invention. In particular, but without limitation, we note that Petitioner appears to rely heavily on purported knowledge that is reposed in the mind and memory of a person of ordinary skill in the art to satisfy the "library" limitation of claim 1 as if the skilled artisan is deemed to be some sort of "walking encyclopedia" or "walking library" of industry literature. Tr. 25:22–24, Serra (Ex. 1003) ¶ 54. We do not accede to this approach to an obviousness analysis.

Obviousness is decided from the standpoint of the hypothetical person of ordinary skill in the art. *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986). To determine patentability, a hypothetical person is presumed to know all the pertinent prior art. *In re Nilssen*, 851 F.2d 1401, 1403 (Fed. Cir. 1988). It is one thing to impute to the person of ordinary skill in the art knowledge of the pertinent art. However, it is an entirely different matter to try to impute to such hypothetical person some vague, amorphous body of "mentally memorized" knowledge that is not objectively defined. It is well settled that rarely, if ever, does skill in the art operate to supply missing knowledge or prior art to reach an obviousness judgment. *Al-Site Corp. v. VSI Int'l, Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999).

5. Davison and Quattlebaum – claims 2–4

In view of the foregoing discussion, it is our determination that Petitioner fails to establish, by a preponderance of the evidence, that claims 2–4 of the '039 Patent are unpatentable over the combination of Davison and Quattlebaum.

6. Davison and Walters – claims 2–4

It is further our determination that Petitioner fails to establish, by a preponderance of the evidence, that claims 2–4 of the '039 Patent are unpatentable over the combination of Davison and Walters.

7. Davison and Smith – claim 5

In view of the foregoing discussion, it is our determination that Petitioner fails to establish, by a preponderance of the evidence, that claim 5 of the '039 Patent is unpatentable over the combination of Davison and Smith.

X. ANTICIPATION OF CLAIM 1 OVER GUINOT

Petitioner alleges that Guinot discloses each and every limitation of claim 1. Pet. 78–84. It does not.

Petitioner alleges that Guinot discloses a library of "shaped charge designs." Pet. 79. Petitioner alleges that Guinot discloses that a liner is one of the primary components of a shaped charge. *Id.* From these two allegations, Petitioner leaps to the unsupported conclusion that Guinot discloses a library of shaped charge liners and the holes that each liner produces. *Id.*

Guinot is directed to an improved shaped charge that is designed to control the production of sand, based on optimizing the geometry and the orientation of perforations. Guinot (Ex. 1010) 3:35–37. Guinot discloses that creating a perforation tunnel with a cross-sectional elliptical shape minimizes sand production, which can block the flow of hydrocarbons into the wellbore. *Id.* 3:44–64. Guinot accomplishes this objective by modifying the case (not the liner) of the shaped charge. *Id.* 4:7–15.

Guinot explains that a shaped charge consists of three primary components: (1) the case; (2) the explosive; and (3) the liner. Guinot (Ex. 1010) 10:60–61. Guinot acknowledges that it is theoretically possible to create non-circular jets by modifying the liner, but then teaches that such is "less desirable" as fabrication of a such a modified liner is more difficult than the comparative ease with which modification to the case can be made. *Id.* 10:61–66. Accordingly, Guinot focuses his work on making design iterations in the case, rather than the liner. *Id.* 10:64–66.

Having reviewed Guinot, the Petition, and Mr. Serra's testimony, we see no evidentiary basis to support a finding that Guinot teaches the creation and/or maintenance of a library that compiles known liner designs that are correlated with the hole shapes formed by such liner designs. We see no evidentiary basis to support a finding that the design process of Guinot selects a liner design from known liner designs that is optimized to a desired hole shape. We see no evidentiary basis to support a finding that the design process of Guinot includes varying a parameter of a liner design to form a modified liner design and then modelling the hole shape that such modified liner design produces.

In the foregoing regard, we find Mr. Serra's testimony to be severely lacking in credibility. Mr. Serra testifies that a shape charge consists of three primary components, namely, a case, an explosive, and a liner. Serra (Ex. 1003), ¶ 12. Guinot is clear and unequivocal that its design process is focused on modifying the case, not the liner. Ex. 1010 (Guinot), 11:1–51. This focus is reflected in Guinot's claims. *Id.* 11:62 – 14:8. Guinot explicitly discourages modifying the liner in favor of modifying the case. *Id.* 10:60–67. Mr. Serra presumably understands the difference between a

shape charge and the liner component of a shape charge, however, in providing an anticipation analysis of Guinot, Mr. Serra obfuscates the distinctions between them and appears to do so deliberately. Serra (Ex. 1003) ¶¶ 160 –173. Mr. Serra uses the term "liner" in the appropriate context when discussing Davison, but then shifts to using the term "shape charge" as satisfying the "liner" element of the claims when discussing Guinot. Whether this was done out of inadvertence, neglect, ignorance, or a deliberate effort to mislead us, this tactic prompts us to severely discount the credibility of his testimony. We are instructed to "disregard the testimony of an expert that is plainly inconsistent with the record, . . . or based on an incorrect understanding of the claim[s]." *Homeland Housewares,* 865 F.3d at 1378.

In view of the foregoing, it is our determination that Petitioner fails to establish, by a preponderance of the evidence, that claim 1 of the '039 Patent is anticipated by Guinot.

XI. UNPATENTABILITY OF CLAIMS 1–5 OVER COMBINATIONS BASED ON GUINOT

1. Guinot and Quattlebaum - Claim 1

At the outset, we apply our findings of fact with regard to the deficiencies of Guinot in the anticipation analysis above with equal force to Petitioner's Section 103 grounds over Guinot and Quattlebaum. As with the anticipation grounds over Guinot discussed above, Petitioner, once again, alleges that Guinot teaches a library of known liner designs including data related to hole shape. Pet. 86. Again, we see no evidentiary basis to support such allegation. Guinot is focused on modifying the case of shaped charges, not the liners. A review of the drawings of Guinot shows that the casing is

modified, but the liners are unchanged. Ex. 1010, Figs. 12–14, 18, 19. If anything, Guinot expressly discourages modifying the liners as being "less desirable" than modifying the casing. *Id.* at 10:63.

Petitioner alleges that it would have been obvious to modify the alleged library of Guinot with liner and corresponding hole data from Quattlebaum to satisfy the library limitation of claim 1. Pet. 86. We disagree for at least two reasons. First of all, there is no teaching in Guinot of creating and/or maintaining a library from which a selection is made based on an optimization analysis. In Guinot, the starting point for development of a modified casing was a "conventional" gun design that produces a circular perforation tunnel. Guinot 10:26–67. There is no evidentiary support for an allegation that Guinot began its design process by selecting a shaped charge from a library based on an optimization analysis of comparing various hole shapes generated by a plurality of shaped charge liners to a desired hole shape. Petitioner's citations to the record do not support its allegations in this regard.

Secondly, but significantly, Petitioner is trying to combine the teachings of one reference, Guinot, that promotes modification of the casing, with a second reference, Quattlebaum, that teaches varying liner parameters. Guinot may be said to "teach away" from a design process that modifies the liner. Guinot explicitly teaches that modifying the liner, while technically possible, is "less desirable" than making modification to the liner when compared to modifying the case. Guinot (Ex. 1010) 10:60–66. "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was

taken by the applicant." *In re Urbanski*, 809 F.3d 1237, 1244 (Fed. Cir. 2016) (citation omitted). Guinot explicitly discourages modifying the liner in a design process in favor of modifying the case.

We agree that Quattlebaum teaches modifying the liner design. Thus, Guinot and Quattlebaum contain conflicting teachings. Where the prior art contains "apparently conflicting" teachings (i.e., where some references teach the combination and others teach away from it) each reference must be considered "for its power to suggest solutions to an artisan of ordinary skill consider[ing] the degree to which one reference might accurately discredit another." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006), quoting *In re Young*, 927 F.2d 588, 591 (Fed. Cir. 1991). In the instant case, Petitioner makes no attempt to reconcile the disparate teachings of Guinot and Quattlebaum. It is not simply a matter that Petitioner engages in an analysis in an attempt to harmonize the teachings of the two references pursuant to *Medichem* and arrives at a conclusion that we disagree with. Here, Petitioner provides us with no analysis on the issue whatsoever for us to consider.

The final limitation of claim 1 is directed to forming an enhanced shape charge liner in accordance with a final liner designer. We are not persuaded, based on Petitioner's presentation, that a skilled practitioner would have been motivated to abandon Guinot's preference for forming a modified casing in favor of forming a modified liner, particularly considering that Guinot starts from the position that liner modification is "less desirable" than case modification.

2. Guinot and Quattlebaum – Claims 2–4

These claims depend from claim 1. Ex. 1001, 13:23–33. Petitioner's grounds of rejection of these claims suffer from the same infirmity that was identified above with respect to claim 1. Thus, for essentially the same reason expressed above in connection with claim 1, Petitioner fails to carry its burden of establishing that claims 2–4 are unpatentable over Guinot and Quattlebaum.

3. Guinot and Walters – Claims 2–4

We have previously discussed the Walters reference with regard to Petitioner's unpatentability grounds over Davison and Walters. With respect to claim 2, Petitioner relies on Walters as teaching varying the thickness of a shape charge liner. Pet. 91. With respect to claim 3, Petitioner relies on Walters as teaching varying the apex angle of a liner. *Id.* With respect to claim 4, Petitioner relies on Walters as disclosing that jet perforator performance can vary depending on the particular materials in the charge case and liner. Pet. 92.

The Petition makes no effort to map the various limitations of claim 1 of the '039 Patent onto Walters. *See* Pet. 70–75, 91–92. Thus, Petitioner presents no evidence from Walters that tends to cure the deficiencies we have previously noted in Guinot under the anticipation grounds of claim 1. We have not independently scoured Walters with a view to augmenting the Petition with factual findings that are not, in the first instance, pointed out with "particularity" in the Petition. 35 U.S.C. § 322(a)(3).

4. Smith (Ex. 1015)

With respect to claim 5, Petitioner relies on Smith for describing studies that evaluate the performance of shaped charge liners for different

types of rock. Pet. 76, 93 (citing Ex. 1015 p. 2). Petitioner alleges that Smith, by evaluating the performance of shaped charges in different types of rock, discloses creation of a library containing such information. Pet. 77, 93. (citing Ex. 1015, p. 2).

Petitioner also alleges that Smith teaches "filtering" of a library of data regarding known liners against rock conditions for a particular well environment. Pet 77, 93 (citing Ex. 1015, pp. 1–2). Petitioner alleges that Smith teaches storing known liner designs based on the compressive strength of targets into which those liners were shot. Pet. 77, 93 (citing Ex. 1015, p. 6). Petitioner alleges that Smith necessarily filters data based on rock type "because it would not be possible to reach these conclusions without at least some filtering of the data based on rock type. Pet. 78, 93 (citing Serra declaration, Ex. 1003 ¶ 156). Petitioner concludes that it would have been obvious to modify Davison to include filtering a library of liner design data against rock conditions for a particular well environment. According to the Petitioner, a person of ordinary skill in the art would have done this to better optimize the liner design for the rock strata to be mined. Pet. 78, 92–93 (citing Serra decl. Ex. 1003 ¶ 157).

We have previously reviewed the Smith reference in connection with the proposed combination of Davison and Smith. *See* pp. 47–50 *supra*. As previously discussed, Smith does not disclose what is required by claim 5. *Id.* Furthermore, the Petition makes no effort to map the various limitations of claim 1 of the '039 Patent onto Smith. *See* Pet. 76–78, 92–93. Thus, Petitioner presents no evidence from Smith that tends to cure the deficiencies we have previously noted under the anticipation grounds of Guinot with respect to claim 1. Guinot does not disclose a "library" of liners

as claimed. Guinot does not disclose selecting an optimized liner design based on comparing hole shapes catalogued in a library. Consequently, the combined teachings of Guinot and Smith fail to disclose a library where correlated liner design and hole shape data is augmented to include hole shapes that are correlated with rock type data. Moreover, since the correlated data is not reposed in a library, the combination also does not teach or suggest a method where library data is filtered according to rock type.

E. Ultimate Conclusion of Obviousness

As with the obviousness grounds over combinations based on Davison, Petitioner's alternative grounds over combinations based on Guinot has significant holes in the evidentiary submission as to each of the claim limitations with respect to each combination of references and each challenged claim. Moreover, as with the Davison grounds, we are not only confronted with gaps in Petitioner's evidentiary presentation in mapping the claim elements onto the prior art, we also note almost a complete absence of an evidentiary presentation as to how or why gaps in the prior art would have been overcome through the exercise of ordinary skill.

1. Guinot and Quattlebaum – claims 2–4

In view of the foregoing discussion, it is our determination that Petitioner fails to establish, by a preponderance of the evidence, that claims 2–4 of the '039 Patent are unpatentable over the combination of Guinot and Quattlebaum.

2. Guinot and Walters – claims 2–4

It is further our determination that Petitioner fails to establish, by a preponderance of the evidence, that claims 2–4 of the '039 Patent are unpatentable over the combination of Guinot and Walters.

3. Guinot and Smith – claim 5

In view of the foregoing discussion, it is our determination that Petitioner fails to establish, by a preponderance of the evidence, that claim 5 of the '039 Patent is unpatentable over the combination of Guinot and Smith.

XII. EXPERT TESIMONY

The record in this proceeding consists of prior art printed publications discussed hereinabove and the testimony of Mr. Serra. We have previously explained why we accord little weight to Serra's testimony.

Generally, "expert testimony is not required when the references and the invention are easily understandable." *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1242 (Fed. Cir. 2010); *see also Belden Inc. v. Berk–Tek LLC,* 805 F.3d 1064, 1079 (Fed. Cir. 2015) (explaining that the Board may, in a proper case, find it easier to understand and explain the teachings and suggestions of prior art without expert assistance). We did not need to rely heavily on expert testimony to decide this case. We are able to understand concepts such as selecting candidate designs from a library and using an iterative design process to converge toward an optimum design without the benefit of expert testimony.

XIII. CONCLUSION

PETITIONER has not shown that is more likely than not that any of the challenged claims of the '039 is unpatentable.

In summary:

Claims	35 U.S.C. §	Basis/References	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–5	101	Eligibility		1–5
1–5	112a	Written Description		1–5
1–5	112a	Enablement		1–5
1–5	112b	Indefiniteness		1–5
1-5	102	Davison		1–5
2–4	103	Davison, Quattlebaum		2–4
2–4	103	Davison, Walters		2–4
5	103	Davison, Smith		5
1	103	Guinot		1
1–4	103	Guinot, Quattlebaum		1–4
2–4	103	Guinot, Walters		2–4
5	103	Guinot, Smith		5
Overall Outcome				1–5

Accordingly, it is:

ORDERED that *none* of the challenged claims (claims 1–5) of the '039 patent is determined to be unpatentable under any or all of the asserted grounds in the Petition;

FURTHER ORDERED that, because this is a Final Written Decision, any 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.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

QINETIQ LIMITED,
Patent Owner.

PGR2023-00003
Patent 11,215,039 B2

Concurring Opinion, filed by *Administrative Patent Judge* DEFRANCO.

Overall, I concur that the Petition should be denied. I write separately only to clarify my reason for doing so. First, I disagree with the majority that the Petition is eligible for post-grant review ("PGR") under 35 U.S.C. § 321(c). Instead, I would deny the Petition for failing to comply with all the statutory requirements for filing a PGR petition before expiration of the 9-month window allowed for such a petition. Second, to the extent the Petition is eligible for post-grant review, I agree with the majority that Petitioner has not met its burden of showing that the claims are unpatentable under 35 U.S.C. §§ 101, 102, and 103. I also agree with Judge Capp that Petitioner has not shown that the claims are unpatentable under 35 U.S.C. § 112, although my analysis of the § 112 challenges differs somewhat from Judge Capp's analysis, as discussed below.

PGR Eligibility

At the outset, I disagree with the majority that this Petition is eligible for post-grant review ("PGR"). *See* Majority Op. (J. Capp), § III. As the majority notes, Patent Owner moved to dismiss the Petition for lack of PGR eligibility because the Petition was untimely filed in contravention of 35 U.S.C. § 321(c). *See* Paper 6. In my dissent to the majority's denial of Patent Owner's motion, I explained my reason for why we should have dismissed the Petition at the institution stage, namely, that the Petition failed to comply with all the statutory requirements for filing a PGR petition before expiration of the 9-month period permitted for such a petition. *See* Paper 8, 20–34.

After institution, the panel revisited the issue of the Petition's eligibility for post-grant review as raised in Patent Owner's motion to dismiss. In particular, during a pre-hearing conference call with the parties, the panel warned Petitioner that the issue of PGR eligibility would be discussed at the oral hearing and that Petitioner should be prepared to defend its position. At the hearing, Petitioner summarized the circumstances of the panel's warning—"After your admonition on the call, we did research the issue and looked for anything from the Board or case law or otherwise, that would speak to the question of the dispute as, really, is it a statutory or regulatory requirement." *See* Paper 18, 36:22–25. The panel then questioned Petitioner on the propriety of its initial denial of Patent Owner's motion to dismiss, but ultimately left that decision intact. *See id.* at 36:4–39:17. With the issue of Patent Owner's motion to dismiss having been raised at the hearing, I again respectfully dissent from the majority's denial of Patent Owner's motion and reiterate my view that the Petition lacks PGR

eligibility for the reasons stated in my initial dissent to the majority's denial of the motion. *See* Paper 8, 20–34.

One last point on this topic. Judge Capp states in the majority opinion on this issue that Patent Owner "does not contest" the issue of PGR eligibility. *See* Majority Op. (J. Capp), § III. I disagree. Patent Owner explicitly contested the issue of PGR eligibility when it filed its motion to dismiss. Moreover, in direct response to an inquiry from the Board during the trial phase of this proceeding, Patent Owner expressly stated that it "does not . . . abandon the contest," thereby preserving its prior position on the issue of PGR eligibility. *See* Paper 14 (Patent Owner reply to Board question #1); *see also* Ex. 1021 (Board email posing six questions to the parties). Indeed, at the hearing, Petitioner acknowledged that the Board was reconsidering the issue of whether the Petition is PGR eligible—"[W]e looked at whether this issue could be revisited at all. And I couldn't come in here and tell you, you can't look at it again." Paper 18, 38:24–39:1. Those events, in my opinion, show that the Petition's PGR eligibility remained a contested issue throughout trial.

Petitioner's § 112 Challenges

In any event, to the extent the Petition is PGR eligible, I agree with Judge Capp that Petitioner has not met its burden in showing that the claims are unpatentable under 35 U.S.C. §§ 101, 102, 103, and 112. I write separately only because I differ somewhat from Judge Capp's reasoning for why Petitioner's § 112 challenges fail.

In particular, I disagree with Judge Capp's analysis of the term "optimized" as used in the context of the "selecting" step of claim 1. *See* Majority Op. (J. Capp), § VII.A.1, at 23–30. Judge Capp believes that

claim 1 recites two aspects of optimization, one in the "selecting" step and another in the steps that follow, i.e., the "varying," "modelling," and "repeating" steps. *See id.* at 27 ("At the beginning of the design process, the hole shape of the design that is initially selected is 'optimized' when compared to other, known designs in the library. At the conclusion of the design process, the modified liner design is 'optimized' relative to other modified liner designs that have been evaluated during the varying and modelling steps."); *see also id.* at 27–28 ("Stated differently and more succinctly, an initial design and associated hole shape is selected because it is optimized with respect to other candidate liners in the library and then it is further optimized through the varying and modelling steps to produce a final, more 'optimized' liner that has converged toward the desired hole shape.").

I disagree with Judge Capp that the claimed "selecting" step involves some sort of initial optimization. Rather, I agree with Judge Saindon, as explained in his dissent, that optimization occurs only after selection of an initial liner design from the library of known liner designs. That said, however, I disagree with Judge Saindon's conclusion that Petitioner has shown that the term "optimized" as used in the claimed "selecting" step is indefinite under § 112(b) and lacks written description support under § 112(a). *See* Pet. 45–50, 53–54.

Between the claim language and the specification, the meaning of "optimized" as used in claim 1 is clear and unambiguous. It refers to the steps that follow the initial "selecting" step, namely, the "varying," "modelling," and "repeating" steps, where the liner design is modified "until the hole shape of the modified liner design converges towards the desired

hole shape to thereby create a final liner design." Ex. 1001, 13:10–20. In other words, the "selecting" step involves nothing more than choosing a baseline design from the library, whereas the subsequent "varying," "modelling," and "repeating" steps involve the process of optimizing the hole shape of that baseline design until it produces the desired hole shape. Indeed, as Judge Saindon correctly notes,

> Reviewing the claim as a whole, it begins by identifying a desired hole shape, consulting a library of designs that produce known hole shapes, selecting a design from the library, *and then proceeding to iteratively modify the selected design until the modified design is expected to produce the desired hole shape*. At a high level, a goal is established, a starting design is chosen, and the design is modified until the design satisfies the goal.

Dissenting Op. 75 (emphasis added).

Likewise, I agree with Judge Saindon that the specification of the '039 patent makes clear that optimization occurs only in the "varying," "modelling," and "repeating" steps, and not in the "selecting" step as the majority believes. *See id.* at 74–75, 79–80. Indeed, the specification describes but a single embodiment of the optimization process, the description and illustration of which appear in column 12 and Figure 16b of the '039 patent. *See* Ex. 1001, 12:3–4, 12:25–63, Fig. 16b. The claimed "selecting" step corresponds to Step 416 of Figure 16b, "select closest liner," while the claimed "varying," "modelling," and "repeating" steps correspond to Steps 418, 420, and 422 of Figure 16b. *See id.* at 12:42–56. As specified, "until the liner performance shows no further improvement" in Steps 418–420 does the process result in "an optimized design . . . that relates to the desired hole shape." *Id.* at 12:53–62. Thus, I agree with Judge Saindon that,

as described in the specification, the hole shape is only optimized in the varying, modelling, and repeating steps, and not the selecting step.

That said, however, I disagree with Judge Saindon's conclusion that "[t]he claims are in tension with the specification because of the word 'optimized.'" Dissenting Op. 77. In his dissent, Judge Saindon reasons that claim 1 "misuses the word 'optimized' in the selecting step" because "the claim applies the word 'optimized' to describe a *starting point* of the design," whereas "[t]he specification . . . uses the word 'optimized' to describe the *ending point* of the design." *Id.* at 75, 77. As such, he surmises that the claim's use of the term "optimized" in the initial step of the method is "internally inconsistent" with the use of the term in the specification. *Id.* at 77. In other words, according to Judge Saindon, if the ultimate purpose of the claimed process is to yield an "optimized" liner design, it makes no sense that the liner design chosen from the library in the selecting step would also be "optimized" since it has yet to undergo the varying and modelling steps.

I disagree that the claimed step of "selecting a liner design . . . that produces a hole shape optimized to the desired hole shape" is conveying that the hole shape is actually optimized at that point. A basic tenet of claim construction is that claims must be read *in light of the specification*. Here, we (meaning Petitioner, Judge Saindon, and I) all agree that the specification makes clear that optimization of the hole shape occurs, *not* as a result of the selecting step (i.e., Step 416), but rather as a result of the varying, modelling, and repeating steps that follow the selecting step (i.e., Steps 418, 420, and 422). With that in mind, one skilled in the art would reasonably understand that the claim is using the verbal phrase "*that produces* a hole shape

optimized to the desired hole shape" in an aspirational sense, in other words, the future tense as opposed to the present tense, something that will happen and not something that is happening. This is made abundantly clear by the claim's recitation of the steps that immediately follow the selecting step, which collectively recite that the hole shape of the selected liner design is varied and modelled "until the hole shape . . . converges towards the desired hole shape." Logically, there would be no need for the hole shape to converge towards a desired hole shape if the hole shape had already been optimized to the desired hole shape. Thus, based on the intrinsic record, the claimed "selecting step" is properly construed to mean that the act of selecting a baseline design from the library means choosing one that *can* produce, or *will* produce, an optimized hole shape.[6]

Moreover, any interpretation that the claimed "selecting" step is referring to an already optimized hole shape violates the basic tenet that claims cannot be construed in a manner that excludes the preferred embodiment. Indisputably, the *sole* optimization process described in the '039 patent is one where the hole shape is optimized *after* the selecting step,

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[6] Indeed, Petitioner and its expert likewise understand that the claimed "selecting" step is speaking in aspirational terms. For instance, in arguing that claim 1 is unpatentable under 35 U.S.C. § 101, Petitioner states, without reservation, that:

> In the selecting step, the known shaped charge liner design *that will yield* a hole shape "most similar" in some respect to the one needed is then the starting point for an optimization process. . . . This is a trivial and entirely routine step that is a standard operational and computational efficiency in any design activity—i.e. choosing a starting position which requires the minimal amount of computational resource, time, and money, and *that is more likely to result* in a successful design."

Pet. 37 (emphases added); Ex. 1003 ¶¶ 57–59.

not as a result of the selecting step. *See* Ex. 1001, 12:25–63, Fig. 16b; *see also* Paper 18, 10:16–17 (Petitioner admitting that "nothing is described in the specification that refers to an optimized starting point"). Yet, the Petitioner and Judge Saindon read claim 1 so as to exclude the only embodiment of the optimization process described in the specification. A claim interpretation that excludes the only embodiment in the specification is "rarely, if ever, correct and would require highly persuasive evidentiary support." *Kaufman v. Microsoft Corp.*, 34 F.4th 1360, 1372 (Fed. Cir. 2022) (quotations and citations omitted).

Here, neither Petitioner nor the dissent point to any meaningful evidence for construing the claimed "selecting" step to exclude the only embodiment of the optimization process described in the specification. Instead, their only point is that the word "optimized" carries its plain and ordinary meaning as something that has occurred, as opposed to something that will occur. *See* Dissenting Op. 76 ("[T]he plain and ordinary meaning of 'optimized' is a word to describe something that has undergone an optimization process."). But that approach reads the term "optimized" in a vacuum and disregards the claim language as a whole, which recites "selecting a liner design . . . *that produces* a hole shape optimized to the desired hole shape." At worst, that limitation raises two equally plausible possibilities—one where the phrase "that produces" indicates an actuality and another where the phrase "that produces" indicates an expectation. So, while Petitioner and the dissent note that the selecting step *could be* read to mean that an optimized hole shape is actually produced in that step of the process, nowhere do they suggest that such a reading makes any sense, especially when doing so would read out the only embodiment described in

the specification. *See* Pet. 46 ("[I]t cannot possibly have been fully optimized to begin with."); Dissenting Op. 75 ("It makes no sense to claim an iterative process for finding an optimized design by requiring somebody to start with an optimized design."). Thus, because Petitioner's and the dissent's position that the claim is indefinite and lacks written description support is premised on an improper claim construction, I concur with the majority that Petitioner has not met its burden to show that the claims are unpatentable under §§ 112(a) and (b).

Conclusion

In sum, I disagree with the majority that the Petition is eligible for post-grant review. But, to the extent the Petition is PGR eligible, I agree with the majority that Petitioner has not shown claims 1–5 to be unpatentable under 35 U.S.C. §§ 101, 102, 103, or 112.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

QINETIQ LIMITED,
Patent Owner.

PGR2023-00003
Patent 11,215,039 B2

Opinion dissenting filed by *Administrative Patent Judge* SAINDON

I agree with Judge Capp that this case is PGR-eligible, on the basis set out in our majority Order denying Patent Owner's motion to dismiss. Paper 8. Patent Owner has acceded to that decision and forfeited any further challenge before us by not filing a rehearing request or brief otherwise challenging PGR eligibility during the proceeding. Accordingly, I see this issue as resolved and with no further discussion necessary. I also agree with my colleagues that Petitioner has not met its burden in showing that the claims are unpatentable under 35 U.S.C. §§ 101, 102, and 103. However, I disagree with my colleagues' treatment of the claim term "optimized" in the

§ 112 grounds.[7] I would interpret *optimized* under its plain and ordinary meaning in the art, where a thing is optimized if it is a result of an optimization process. In my view, under the correct interpretation of the claims, Petitioner has met its burden in showing that the claims are unpatentable under 35 U.S.C. § 112(b) for being indefinite and under § 112(a) for lacking written description support. Because I would reach a different outcome, I respectfully dissent.

A. "Optimized" in Claim 1

The purpose of claim 1, as defined in the preamble, is to manufacture a shaped charge liner design that forms a desired hole shape. The first step is "comparing the desired hole shape to a library of known liner designs." The claim states that the library has information about the hole shape each liner design is known to create. The claim here reveals two very important implications. First, that a given liner design produces a given hole shape. Second, that if one desires a specific hole shape, one can review the library to find a liner design that gives (or is closest to) that hole shape.[8]

With those implications in mind, the next step asks to "select[] a liner design from the [library] that produces a hole shape *optimized to the desired hole shape*" (emphasis added). The next three limitations of "varying," "modeling," and "repeating" involve making changes to the selected liner design so that it "converges towards the desired hole shape." The liner

[7] In the interest of consistency, I adopt my colleagues' convention on the spelling of the word "optimized."

[8] Given the correspondence of design and hole shape, if I refer to an "optimized design," that is the same as me saying a design optimized to form a particular hole shape.

design resulting from this iterative process is called the "final liner design." In the last step of the claim, the final liner design is formed (i.e., made).

Reviewing the claim as a whole, it begins by identifying a desired hole shape, consulting a library of designs that produce known hole shapes, selecting a design from the library, and then proceeding to iteratively modify the selected design until the modified design is expected to produce the desired hole shape. At a high level, a goal is established, a starting design is chosen, and the design is modified until the design satisfies the goal.

The problem, however, is that the claim misuses the word "optimized" in the selecting step. As will be made clear by reviewing the specification, the claimed final liner design is the optimized design. Yet the claim starts by selecting an optimized design. It makes no sense to claim an iterative process for finding an optimized design by requiring somebody to start with an optimized design.

B. *"Optimized" in the Specification & Prior Art*

The specification describes Figure 16b as including a "process of liner/charge optimization" or more simply, an "optimization method." Ex. 1001, 12:3–4, 12:25. The optimization method comprises various steps such as noting desired hole parameters, searching a library to find a shaped charge liner closest to the desired hole shape, and then iteratively modifying a parameter of the liner and modeling its expected performance. *Id.* at 12:25–56. At some point, the modified initial design converges toward a design that produces the desired hole shape. *Id.* at 12:57–58. According to the specification of the '039 patent, the *result* of the optimization method is the optimized design. *Id.* at 12:60–63 ("[t]he resultant shaped charge liner design represents an optimized design . . . that relates to the desired hole

shape"); *see also* Ex. 1003 ¶ 91 (unrebutted expert testimony that "the only use of the term 'optimize' in the specification describes the results of the entire claimed process"). The starting design, on the other hand, is selected based on it being closest to the design that produces the desired hole shape. *Id.* at 12:42–44. In my view, this makes sense. An optimization method is something that iteratively improves upon a design until it reaches some target state. *Id.* at 12:52–62. One would naturally want to start with the design closest to providing the desired characteristics in order to minimize the number of modifications required to reach the goal. The specification is consistent with these views. On the other hand, I do not find any indication that the specification intends an "optimized" design to be a design *to be optimized*.

The prior art also consistently presents an "optimized" design as being a *result* of an optimization process. Like the '039 patent, Smith discloses modeling variations in parameters to improve on an initial design and result in an optimized design. Ex. 1015, 3 ("Design iterations are then performed to obtain an optimum design."). Quattlebaum describes varying parameters to optimize performance. Ex. 1007, 8. Poulter also discusses modifying an initial design to result in a better, or "optimum," design. Ex. 1008, 12:31–33 ("[I]t is possible to 'tailor' a charge design for optimum performance.").

Accordingly, my review of the specification and prior art leads me to conclude that the plain and ordinary meaning of "optimized" is a word to describe something that has undergone an optimization process (i.e., an iterative improvement process). Turning back to claim 1, then, we have a step of "selecting a liner design . . . that produces a hole shape optimized to the desired hole shape." In the context of claim 1, this step is picking an

initial design that is then iterated upon in the "varying," "modeling," and "repeating" steps that make up the "optimization method," just as described in the specification. Ex. 1001, Fig. 16b, 12:25–63. The "selecting" step maps onto Step 416 of Figure 16b, "select closest liner." *Id.* at 12:42–44. The claimed "final liner design" maps onto the design that passes the convergence check of Step 422 in order to end the process. *Id.* at 12:60–63. Notably, the "final liner design" is an "optimized design." *Id.* The claims are in tension with the specification because of the word "optimized."

C. *Indefiniteness*

Using the word "optimized" in the claim to describe the *initial* design causes a problem. The claim purports to begin with a liner design that is optimized to produce the desired hole shape, and then modifies it to achieve a final design that (also?) produces the desired hole shape. In this way, the claim applies the word "optimized" to describe a *starting point* of the design. The specification, however, uses the word "optimized" to describe the *ending point* of the design. Ex. 1002, 101:32–33, 112:4, 112:30, 112:31–32 (each reproduced *supra*). Thus, the claim's use of the term "optimized" in the initial step of the method to make a final enhanced shaped liner is internally inconsistent with the use of the term throughout the specification. *In re Cohn*, 438 F.2d 989, 993 (CCPA 1971) (sustaining rejection of claims under 35 U.S.C. § 112, second paragraph, as being indefinite when the claims were "inherently inconsistent" with the description, definitions, and examples appearing in applicant's specification); *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357 (Fed. Cir. 1999) ("While we have held many times that a patentee can act as his own lexicographer to specifically define terms of a claim contrary

to their ordinary meaning[, the patentee must clearly redefine the term] so as to put a reasonable competitor or one reasonably skilled in the art on notice that the patentee intended to so redefine that claim term."). In my view, when a claim term is used in a manner contrary to every other use of that term in the specification (and its use in the art), it cannot be said to provide one of ordinary skill in the art with "reasonable certainty" about the scope of the invention and must be held indefinite. *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910 (2014) (holding that 35 U.S.C. § 112 requires that "a patent's claims, viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty").[9] The present use of "optimized" therefore presents an impossibility, similar to the claims in *Synchronoss Technologies, Inc. v. Dropbox, Inc.*, 987 F. 3d 1358 (Fed. Cir. 2021). There, the Federal Circuit stated that "the asserted claims of the '446 patent are nonsensical and require an impossibility—that the digital media file contain a directory of digital media files." *Synchronoss*, 987 F.3d at 1366–67. Similarly, in *Allen Engineering Corp. v. Bartell Industries, Inc.*, 299 F.3d 1336 (Fed. Cir. 2002), the Federal Circuit rejected the argument that "perpendicular" would be understood as "parallel" in light of the

[9] The problems with the word "optimized" are perhaps clearer when considering the term's use in an infringement context. The fact that an initial design is later improved would appear to prove that it was not optimized to begin with, questioning whether the claim could ever be infringed. *Cf. Nautilus*, 572 U.S. at 909 (framing the purpose of the definiteness requirement in terms of the public's ability to determine whether or not they infringe the claims); *see also* Ex. 1003 ¶ 71 (reasoning that because "the 'optimized' design was improved by the subsequent steps, . . . the selected liner design was not 'optimized' to begin with").

specification's teachings. 299 F.3d at 1349. The court explained that "[w]here it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention, we must hold that claim invalid under § 112, paragraph 2." *Id.* "Moreover, it is of no moment that the contradiction is obvious." *Id.* A court should not rewrite claims to preserve their validity. *Id.* These cases are in alignment with the present case, where the word "optimized" in the claim is being used in a different way from what the '039 patent describes as "optimized."

I have considered construing "optimized" to be an aspirational label, i.e., the selected design is *to be* optimized, as the concurring opinion has done, but it is my view that such an interpretation is confusing and inconsistent with the plain meaning of the term. Giving "optimized" an aspirational meaning reads the term out of the claim because it no longer means "optimized." There is no evidence in the specification that the inventors considered "optimized" to be an aspirational term; the specification and prior art use the term literally, in accordance with the plain meaning. Also, "optimized" has the ending "ed" indicating past tense, which is consistent with the specification's description of a "optimized" design being one that has *undergone* an optimization process. *See, e.g.*, Ex. 1001, 12:60–63.

Further, the specification does not describe two optimization processes, to support a notion that the selecting step is the result of some undisclosed first optimization process, as Judge Capp's opinion has proposed. I do not disagree that some process may contain two sequential optimization processes. But that would require two sequential iterative

improvement processes. The specification of the '039 patent only has one iterative improvement process. *See, e.g.*, Ex. 1001, Fig. 16B (noting the iteration depicted by steps 418, 420, and 422). The selecting step has no iterative process associated with it (*see, e.g.*, *id.* at Fig. 16B (step 416)) and thus cannot be shoehorned into a first optimization process.

I have also considered whether "a hole shape optimized to the desired hole shape" means that such a hole shape merely has to be close or reasonably approximate to the desired hole shape. The claims do not say that, and as I will go over in the written description section, the applicant did originally have the word "closest" but removed it in favor of "optimized" in response to the examiner rejecting "closest" as indefinite. Accordingly, I think it is improper to construe the "selecting" limitation to mean that it requires picking a design closest to or reasonably approximate to the desired hole shape. *Cf. Schriber-Schroth Co. v. Cleveland Trust Co.*, 311 U.S. 211, 220–21 (1940) ("It is a rule of patent construction consistently observed that a claim in a patent as allowed must be read and interpreted with reference to claims that have been cancelled or rejected, and the claims allowed cannot by construction be read to cover what was thus eliminated from the patent."); *Standard Oil Co. v. Am. Cyanamid Co.*, 774 F.2d 448, 452 (Fed. Cir. 1985) (ruling that "the prosecution history (or file wrapper) limits the interpretation of claims so as to exclude any interpretation that may have been disclaimed or disavowed during prosecution in order to obtain claim allowance"). In my view, these construction approaches are attempting to construe the claim to say something it does not.

In summary, the specification uses a term (optimized) in an ordinary manner consistent with a person of ordinary skill in the art's understanding

of the term. Then the claim uses the term in an irreconcilably contradictory and nonsensical manner. I do not believe we can paper over the claim's misuse of the word "optimized," regardless of how clear the claims could be if we simply ignored the word or assigned it some new meaning. Accordingly, I agree with Petitioner that claims 1–5 are unpatentable for being indefinite. *See* Pet. 46 (arguing, *inter alia*, that the claimed optimized design "cannot possibly have been fully 'optimized' to begin with"). I respectfully dissent from my colleagues' decision to the contrary.

D. *Written Description*

The claim term at issue, "optimized," was added to the claims in response to an indefiniteness rejection during prosecution. Specifically, originally filed claim 1 included a limitation of "selecting a liner design that produces a *closest* hole shape to the desired hole shape." Ex. 1002, 114 (emphasis added). The examiner rejected claim 1 as indefinite, stating that the term "closest" "is a relative term which renders the claim indefinite." *Id.* at 57. The examiner further noted that "[t]he specification and claims are silent as to how [a determination of what is 'closest'] is accomplished." *Id.* In response, the applicant removed the word "closest" and substituted in the word "optimized." *Id.* at 35. The applicant asserted, without explanation, that this amendment "make[s] the claim definite." *Id.* at 41. The appellant further asserted that "[s]upport for this amendment can be found at least in Applicant's Specification at page 19, lines 4–7," but no explanation is provided. *Id.* The examiner then asserted, without explanation, that "Applicant's arguments . . . have been fully considered and are persuasive" (*id.* at 12) and proceeded to allow the claim (*id.* at 13–14).

For purposes of my analysis of written description support, this prosecution history is particularly important. Notably, the appellant relied on page 19 of the specification for written description support of the term "optimized" hole shape. *Id.* at 41. The specific passage relied on by the applicant is reproduced below:

> Returning to the optimization method shown in Figure 16b, in Step 412, parameters relating to a desired hole to be formed in the rock adjacent to an oil/gas well are received. Such parameters may comprise the required hole depth and the general hole profile required (e.g. "slot like" cross-section).

Ex. 1002, 112; *see also* Ex. 1001, 12:25–30 (same passage).

Figure 16B, referenced in the above passage, is reproduced below:

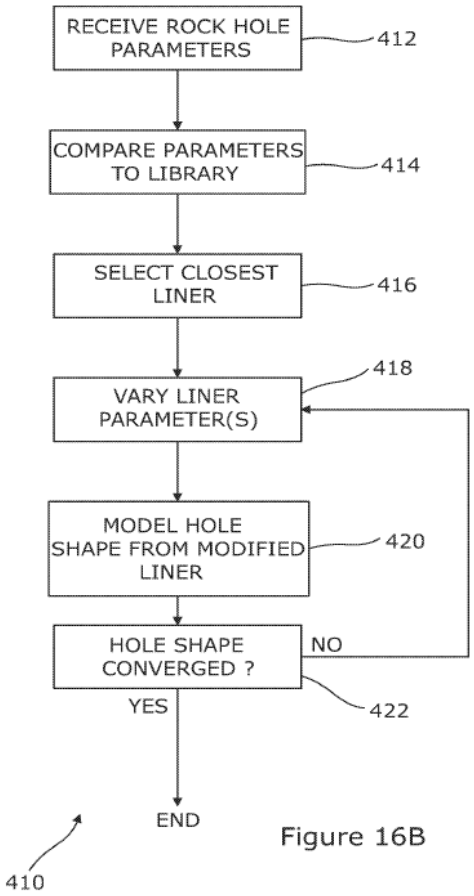

Figure 16B

Ex. 1001, Fig. 16B.

Reviewing the passage of the specification cited by the applicant in context, I am unable to determine any support for a step of selecting a liner design that produces a hole shape *optimized* to the desired hole shape as recited in claim 1. The paragraph applicant cited for written description support of "optimized" is explicitly discussing step 412, which deals with receiving information about the desired hole. *Id.* at 12:25–30. It has nothing to do with selecting a design optimized to the desired hole shape. On the other hand, the step in Figure 16B that best matches the "selecting a liner design . . . that produces a hole shape optimized to the desired hole shape" limitation is found later in the process, in step 416. *Id.* at 12:42–44, Fig. 16B (Step 416, labeled "select closest liner"). In fact, the specification uses the claim language almost verbatim: "In Step 416, the shaped charge liner within the library that results in a hole that is closest to the desired hole shape is chosen." *Id.* at 12:42–44. The only difference is that the word "closest," which appears in original claim 1 and in the specification, has been replaced with "optimized" in amended claim 1.

In contrast to this undisclosed step of selecting a "design . . . that produces a hole shape *optimized* to the desired hole shape" (emphasis added), the specification uses the word "optimization" in reference to the process as a whole, not a step, and the word "optimized" in reference to the *result* of the process, not a starting point. *Id.* at 6:7–8 (referencing "a method of optimizing a shaped charge liner design"), 12:25 (referencing "the optimization method shown in Figure 16b"), 12:58 (referencing "the optimization method"), 12:59–61 (noting that "[t]he resultant shaped charge liner design represents an optimized design"). Thus, the applicant was trying to replace the "closest" language in the "selecting a liner design"

step 416 with language that has nothing to do with selecting a liner design, and is instead trying to take a different word used in a different context. Accordingly, in my view, the specification has no support for a step of *selecting* a liner design that produces a hole shape optimized to the desired hole shape. The specification makes clear that the process as a whole is an optimization process, the result of which is an optimized design. Existing claim 1 uses the so-called optimized design as a starting point, which is the opposite of how the specification uses the term (a point which is more salient in my indefiniteness analysis). The claim's use of the term "optimized" is therefore in conflict with the specification.

I would not construe "optimized" in claim 1 to mean something to the effect of "closest" because of the prosecution history, which clearly shows that the applicant removed the word "closest" in order to overcome an indefiniteness rejection. Ex. 1002, 35, 41, 57. In my view, it is improper to construe "optimized" in claim 1 to mean something like "closest" or "reasonably approximate" when the applicant removed the word "closest" to escape an indefiniteness rejection. *Cf. Schriber-Schroth Co. v. Cleveland Trust Co.*, 311 U.S. at 220–21; *Standard Oil Co. v. Am. Cyanamid Co.*, 774 F.2d at 452; *Omega Engineering, Inc v. Raytek Corp.*, 334 F.3d 1314, 1323–26 (Fed. Cir. 2003). Thus, I would not find written description support for the word "optimized" in the passages that use the word "closest" in the specification.

For the reasons above, I agree with Petitioner's analysis (Pet. 53–54) on the issue of written description, and would hold claims 1–5 unpatentable for lacking written description support for a step of selecting a liner design

"optimized to [produce] the desired hole shape." I respectfully dissent from my colleagues' decision to the contrary.

E. *Conclusion*

In summary, I agree with the majority that Petitioner has not shown claims 1–5 to be unpatentable under 35 U.S.C. §§ 101, 102, or 103. However, I would hold that Petitioner has shown claims 1–5 to be unpatentable under 35 U.S.C. §§ 112(a) and 112(b). Therefore, I respectfully dissent from the majority opinion.

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