

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MARKFORGED INC.,
Petitioner,

v.

CONTINUOUS COMPOSITES, INC.,
Patent Owner.

IPR2022-00679
Patent 10,744,708 B2

Before GRACE KARAFFA OBERMANN, JO-ANNE M. KOKOSKI,
and SHELDON M. McGEE, *Administrative Patent Judges*.

McGEE, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

This is a Final Written Decision in an *inter partes* review of claims 1–21 of U.S. Patent No. 10,744,708 B2 (Ex. 1001, “the ’708 patent”). We have jurisdiction under 35 U.S.C. § 6 and enter this Decision pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner fails to establish that any of the challenged claims are unpatentable.

A. PROCEDURAL HISTORY

Petitioner filed a Petition (Paper 2, “Pet.”) requesting institution of an *inter partes* review of claims 1–21 of the ’708 patent. Patent Owner filed a Preliminary Response. Paper 6. We entered an Institution Decision (Paper 7, “Dec.”) instituting review of all challenged claims based on all grounds of unpatentability asserted in the Petition. Thereafter, in timely sequence, Patent Owner filed a Response (Paper 9, “Resp.”), Petitioner filed a Reply (Paper 10, “Reply”), and Patent Owner filed a Sur-reply (Paper 14, “Sur-reply”). In addition, briefing was received in connection with Patent Owner’s objections to Petitioner’s evidence. Paper 11.¹

With Board pre-authorization, Patent Owner submitted an identification of allegedly improper evidence and arguments in the Reply and Petitioner submitted a response thereto. *See* Papers 12, 13.²

¹ Patent Owner did not preserve its objections by filing a Motion to Exclude evidence. 37 C.F.R. § 42.64(c). Additionally, Patent Owner’s objections to evidence are moot because we do not rely on any of the objected-to evidence in reaching our decision.

² We address Patent Owner’s arguments contained in Paper 12 herein, but do not rely on the cited portions of Exhibits 1017, 1024, and 1025 in this Decision. To the extent we consider Petitioner’s objected-to argument regarding the simplicity of Ma’s passive method (Paper 12, 2 (citing Reply, p. 26, ll. 8–14)), we find that argument and evidence outweighed by

The Petition sets forth ten grounds of unpatentability:

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1	20, 21	103(a) ³	Lipsker ⁴
2	1–4, 9–12, 20, 21	103(a)	Lipsker, Ma ⁵
3	5–8	103(a)	Lipsker, Crump ⁶
4	13–19	103(a)	Lipsker, Nikzad ⁷
5	1, 2, 9, 10, 21	103(a)	Ma
6	3, 4, 11, 12, 20	103(a)	Ma, Lipsker
7	5, 6	103(a)	Ma, Crump
8	7, 8	103(a)	Ma, Crump, Lipsker

competing evidence cited by Patent Owner as discussed *infra*.

³ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (September 16, 2011), includes revisions to Section 103 that became effective on March 16, 2013. Because the ’708 patent issued from an application claiming priority to a provisional application filed August 29, 2012, and the parties do not dispute that the challenged claims are entitled to this priority date, we apply the pre-AIA statutory provisions in this proceeding. Ex. 1001, code (60). In any event, neither party directs us to information indicating that the result would change based on which version of the statute is applied in this case.

⁴ US 6,153,034 (Ex. 1006).

⁵ *Solid Freeform Fabrication of Continuous Fiber Reinforced Composite Materials* (August 6, 2001) (Ph.D. dissertation, Auburn University) (UMI Number 3016100) (Ex. 1007).

⁶ US 5,121,329 (Ex. 1008).

⁷ *New Metal/Polymer Composites for Fused Deposition Modelling Applications* (May 2011) (Ph.D. thesis, Swinburne University of Technology) (Ex. 1009).

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
9	13, 14	103(a)	Ma, Nikzad
10	15–19	103(a)	Ma, Nikzad, Lipsker

Pet. 3–4. Petitioner submits two declarations from Dr. David Rosen, Ph.D. (Ex. 1002; Ex. 1017) in support of its contentions.

Patent Owner statutorily disclaimed claims 13–19 on July 25, 2023, rendering Petitioner’s Grounds 4, 9, and 10 moot. Ex. 2008. Thus, our Final Written Decision does not address Petitioner’s Grounds 4, 9, and 10. The Board heard oral arguments in an in-person hearing conducted on July 27, 2023. *See* Paper 23.

B. REAL PARTIES-IN-INTEREST

Patent Owner, Continuous Composites, Inc., identifies itself as the real party-in-interest. Paper 21, 1. Petitioner, Markforged Inc., identifies itself as the real party-in-interest. Pet. 1.

C. RELATED MATTERS

The parties identify a district court action as a related matter: *Continuous Composites, Inc. v. Markforged, Inc.*, No. 1:21-cv-00998-MN (D. Del.). Pet. 1; Paper 5, 1. Patent Owner also identifies IPR2022-00548, IPR2022-00652, and IPR2022-00732,⁸ as well as pending U.S. Patent Applications 16/946,469, 17/481,147, 17/453,309, 17/453,313, 17/488,941, 17/660,133, 18/065,568, 18/065,595, and 18/156,368 as related matters. Paper 5, 1; Paper 21, 1.

⁸ The petitions in these three proceedings were denied on September 9, 2022. IPR2022-00548, Paper 8; IPR2022-00652, Paper 8; IPR2022-00732, Paper 7.

II. BACKGROUND

A. THE '708 PATENT (EX. 1001)

The '708 patent relates to “[a] method and apparatus for the additive manufactur[e] of three-dimensional objects” where “[t]wo or more materials are extruded simultaneously as a composite, with at least one material in liquid form and at least one material in a solid continuous strand completely encased within the liquid material.” Ex. 1001, code (57). According to the '708 patent, this “method is called Continuous Composite Three-Dimensional Printing (CC3D).” *Id.* at 2:12–13.

The '708 patent indicates that the primary material is a curable liquid, such as a photosensitive resin, and the secondary material is a solid strand, such as carbon fiber. *Id.* at 2:25–28. “These two materials are extruded together, with the secondary material fully encased within the primary material,” thus creating a composite material. *Id.* at 2:28–30. “The use of CC3D with various composites[] allows for increased flexibility in design and function” because “[c]omposite material adds strength during the manufacturing, allowing paths to extend in three dimensions, rather than along horizontal planes” common in traditional additive manufacturing. *Id.* at 2:65–3:2.

The '708 patent teaches that “[p]rior to manufacturing a part, the manufacturer designates an origin,” which is “any point on a surface suitable for anchoring the part during manufacturing. This point of contact is called an anchor.” *Id.* at 8:37–40. Once the composite material is first extruded onto a surface, an anchor point is established, thus “allowing the extruder to pull on the secondary material during the extrusion.” *Id.* at 10:4–9. Figure 9

of the Drawings, reproduced below, illustrates this pulling action from the extruder:

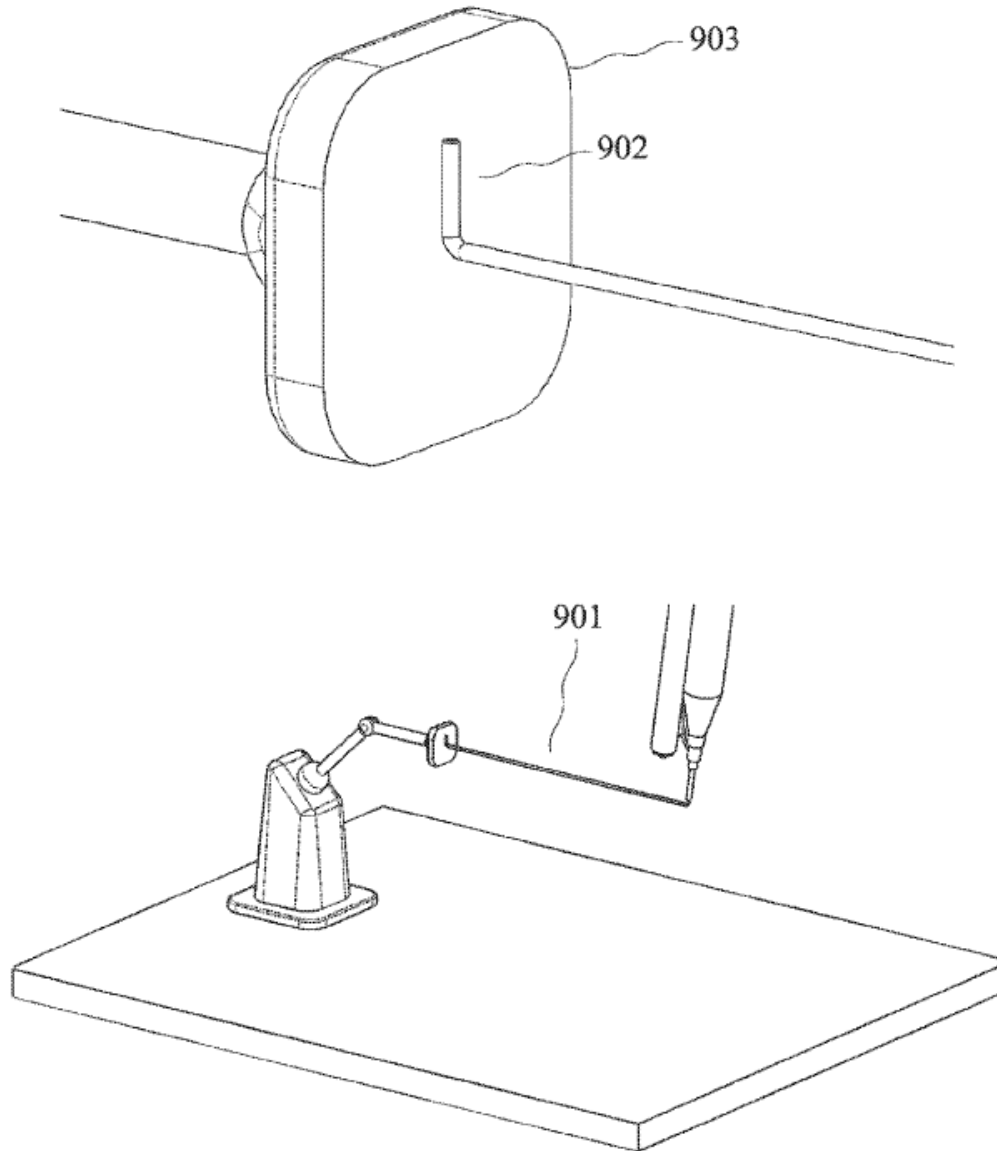


Fig. 9

Figure 9 shows a short length of composite path 902 extruded onto and adhered to vertical plane anchor 903, and depicts an extruder pulling tension path 901 in a horizontal direction away from anchor 903. *Id.* at 10:4–20. “The initial contact between the proposed part and the anchor must

provide enough adhesion to support the tension force desired.” *Id.* at 10:14–16.

B. CHALLENGED CLAIMS

Petitioner challenges claims 1–21 of the ’708 patent (Pet. 3–4), but claims 13–19 have been statutorily disclaimed. Ex. 2008. Because there are five remaining challenged independent claims, we reproduce those claims in the relevant subsections of our “Analysis” below.

III. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the art at the time of the invention is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int’l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

Petitioner contends that a person having ordinary skill in the art (“POSITA”) would have had a master’s or bachelor’s degree in mechanical engineering, materials science, or a related degree, and either at least 3–5 years of experience (with a master’s degree), or at least 5–6 years of experience (with a bachelor’s degree), in composite materials or additive manufacturing. Pet. 13–14 (citing Ex. 1002 ¶ 36). Patent Owner states that it “does not agree that Petitioner’s proposed level of skill in the art accurately reflects the level of ordinary skill in the art as of the priority date . . . [, but r]egardless [of] the level of skill, . . . the Petition does not show the challenged claims are unpatentable.” Resp. 14–15. Patent Owner does not propose a different level of skill in the art. *See id.* at 15 (“Patent Owner

reserves the right to propose a level of ordinary skill in the art later in this proceeding, or in other proceedings.”).

On this record, we determine that the level of ordinary skill is reflected in the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (specific findings on the ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown” (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985))). Although a more specific definition is not necessary, we adopt Petitioner’s proposed definition because, on this record, it is consistent with the disclosures of the asserted prior art references. Neither party, however, advances information explaining how or why the result in this case would change based on the level of ordinary skill determined by the Board.

B. CLAIM CONSTRUCTION

We construe each claim “in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b). Under that standard, 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 art in question at the time of the invention, i.e., as of the effective filing date of the patent application.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc) (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)). We construe terms in controversy only to the extent necessary to resolve the controversy. *See Nidec Motor Corp. v. Zhongshan Broad*

Ocean Motor Co., 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner advances no specific construction of any claim term, but rather proposes that “claim terms should be given their plain and ordinary meaning.” Pet. 14. Patent Owner asserts that the term “anchor” should be construed according to its plain and ordinary meaning, which, according to Patent Owner, is “contact to which the path of composite material is adhered to enable pulling of the path.” Resp. 15 (citing Ex. 2006, 2, 53). Petitioner responds that “[i]n the parallel litigation, the Court has construed ‘anchor point’ and ‘anchor’ as ‘a contact point to which the path is affixed and that serves as an origin point for the formation of the path.’” Reply 3.

On the complete record, we determine that no claim term needs an express construction to resolve the controversy.

C. GROUND 1 – ALLEGED OBVIOUSNESS OF CLAIMS 20 AND 21 OVER LIPSKER

1. The Challenged Claims

Independent claims 20 and 21—each challenged as obvious over Lipsker—are reproduced below, along with the limitation identifiers provided by Petitioner for ease of reference.

20. [pre] A method of additively manufacturing a three-dimensional object, the method comprising:
[a] emitting from an extruder a path of composite material containing a continuous strand encased in a primary material,
[b] the continuous strand being at least one of a wire and a fiber;
[c] hardening the path after emission; and
[d] selectively cutting the continuous strand before the path of composite material is emitted such that at least a portion of the path emitting from the extruder contains only the primary material.

21. [pre] A method of additively manufacturing a three-dimensional object, the method comprising:
- [a] emitting from an extruder a path of composite material containing a continuous strand encased in a primary material,
 - [b] the continuous strand being at least one of a wire and a fiber;
 - [c] adjusting a trajectory of the path of composite material to a new location after emission from the extruder; and
 - [d] hardening the path after adjustment.

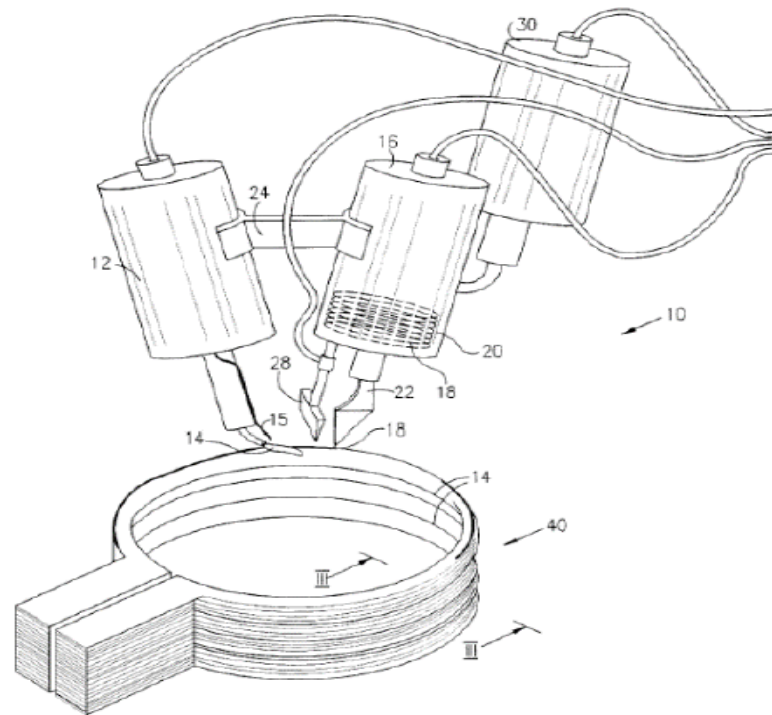
Ex. 1001, 12:31–50.

2. *Overview of Lipsker (Ex. 1006)*

Lipsker is directed “to rapid prototype deposition modeling techniques and apparatus.” Ex. 1006, 1:4–6. In particular, Lipsker “seeks to provide improved rapid prototype deposition modeling techniques and apparatus wherein a building material is added layer by layer to build an accurate replica of a given object, without having to remove building material to arrive at the finished prototype.” *Id.* at 1:52–56.

Lipsker discloses numerous embodiments such as that depicted in Figure 2, reproduced below.

FIG. 2



Lipsker’s Figure 2, reproduced above, “is a simplified pictorial illustration of the rapid prototype apparatus of [the embodiment depicted in Figure] 1 forming a prototype of a three-dimensional object.” Ex. 1006, 3:1–3; 2:65–67 (identifying Figure 1 as “a preferred embodiment”).

Prototype apparatus 10 in Figure 2 includes adhesive dispenser 12 for dispensing adhesive 14 and wire dispenser 16 for dispensing wire 18 separately from the adhesive. *Id.* at 3:27–28, 3:46–47. Lipsker explains that actuator 30 “dispenses layers of wire 18 in accordance with the geometry of object 34, and adhesive dispenser 12 applies adhesive 14 to wire 18 so as to bond a previously dispensed portion of wire 18 to a presently dispensed portion of wire 18.” *Id.* at 5:24–28. When adhesive 14 cures, the layers of wire 18 form a prototype of object 34. *Id.* at 5:30–31.

Lipsker also discloses “an alternative method of applying adhesive 14 to wire 18” where “[a]dhesive dispenser 12 may be located so as to dispense adhesive 14 into nozzle 22 such that wire 18 is dispensed from wire dispenser 16 pre-coated with adhesive 14.” *Id.* at 5:53–60. This alternative method is illustrated in Figure 5, reproduced below:

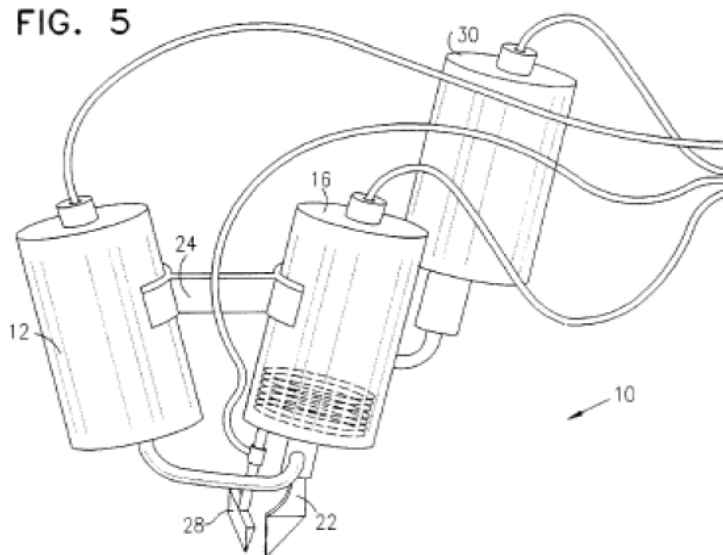


Figure 5 “illustrates an alternative method of applying adhesive 14 to wire 18, in accordance with a preferred embodiment” where “[a]dhesive dispenser 12 may be located so as to dispense adhesive 14 into nozzle 22 such that wire 18 is dispensed from wire dispenser 16 pre-coated with adhesive 14.” *Id.* at 5:53–59.

Lipsker discloses “yet another preferred embodiment” where the wire dispenser “is a holding instrument, such as tweezers, tongs or pliers” which may also have a wire cutter provided along with the dispenser. Ex. 1006, 4:25–31. This preferred embodiment is illustrated in Figures 4C and 4D, reproduced below.

FIG. 4C

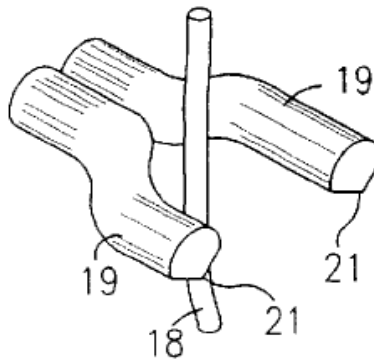
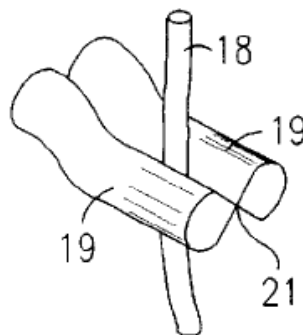


FIG. 4D



Lipsker's Figures 4C and 4D illustrate an embodiment where wire dispenser 19 is capable of holding wire 18, as well as cutting wire 18 with cutter 21.
Ex. 1006, 4:25–31.

3. *Analysis of Petitioner's Challenge of Claim 20 over Lipsker*

Petitioner's assertions regarding claim 20 are set forth at pages 23–31 of the Petition. Relevant to our disposition of this challenge, Petitioner relies on Lipsker's Figure 2 embodiment for elements 20[pre] and 20[c], Lipsker's Figure 5 embodiment for element 20[a], and Figures 4A, 4C, and 4D for element 20[d]. Pet. 23–31.

Patent Owner argues that Petitioner's challenge is insufficient to establish obviousness for essentially two reasons:

- 1) Petitioner relies improperly on distinct embodiments of Lipsker to satisfy elements 20[pre], 20[a], 20[b], and 20[c], because Petitioner does not provide a reason to combine any aspect of those embodiments with a reasonable expectation of success; and
- 2) Petitioner does not establish that Lipsker meets the requirement of element 20[d] regarding "selectively cutting the continuous strand before the path of composite material is emitted."

Resp. 27–35.

We agree with Patent Owner, and determine that Petitioner does not establish sufficiently that claim 20 would have been obvious over Lipsker.

a. Mixing and Matching Lipsker Embodiments

Patent Owner correctly states the legal requirements pertaining to combining multiple embodiments from a single prior art reference (Resp. 31), i.e., "there must be a motivation to make the combination and a reasonable expectation that such a combination would be successful, otherwise a skilled artisan would not arrive at the claimed combination." *In re Stepan*, 868 F.3d 1342, 1346 n.1 (Fed. Cir. 2017).

On this record, Petitioner fails to provide any such motivation to combine the embodiment in Lipsker's Figure 2 with those of Figures 4A, 4B, 4C, and 5 to arrive at the subject matter of claim 20. Pet. 23–31. Rather, Petitioner merely points to the disparate embodiments of Figures 2, 4A, 4B, 4C, and 5 and portions of Lipsker's disclosure pertaining to those embodiments, and asserts that Lipsker "discloses" the individual limitations recited in claim 20. *See, e.g., id.* at 25 (Petitioner, relying on Figure 2,

asserting that “Lipsker discloses the preamble of Claim 20”), 27 (Petitioner, relying on Figure 5, asserting that “Lipsker discloses Element 20[a]”), 28 (quoting Lipsker’s descriptions of wire and adhesive dispensed *separately* as depicted in Figure 2, and asserting “Lipsker discloses Element 20 [c]”), 29 (pointing to Figures 4A, 4B, and 4C and asserting “Lipsker discloses Element 20[d]”). Pointing to disparate embodiments without providing a sufficient motivation to combine them is not enough to establish the obviousness of claim 20 as a whole. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (holding that a claim “composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art”).

Here, we are not persuaded by Petitioner’s argument that it does not rely on separate embodiments within Lipsker because that argument is contradicted by the express teachings of Lipsker. Reply 3–6. Lipsker describes Figures 2 and 5 as “alternative” methods for applying adhesive to a wire, and Figures 4C and 4D as “constructed and operative in accordance with yet another preferred embodiment of the present invention.” Ex. 1006, 3:11–13, 4:25–28, 5:53–56. And Petitioner’s reference to Lipsker’s statement that “various features of the invention which are, for clarity, described in the contexts of separate embodiments^[9] may also be provided in combination in a single embodiment” is insufficient to establish obviousness of claim 20. Ex. 1006, 6:56–59. While Petitioner is correct that “Lipsker’s precoating and non-precoating disclosures share” some common elements (Reply 4), Lipsker’s generic passage regarding “various features” that “may”

⁹ This statement further undercuts Petitioner’s argument that it does not rely on separate embodiments within Lipsker. Reply 3–4.

be provided in a single embodiment lacks specificity and precision. Even further, this statement falls short of describing why a person of ordinary skill in the art would have been motivated to combine such features. *See* Sur-reply 5 (“[T]his attorney-added boilerplate does not describe *which* features of *which* embodiments ‘may’ be combined or why.”). We therefore agree with Patent Owner that Petitioner’s reliance on multiple embodiments within Lipsker is deficient because Petitioner does not establish that a person of ordinary skill in the art would have combined the disparate features of the relied-upon embodiments with a reasonable expectation of success.

b. Element 20[d]

We also agree that Petitioner fails to establish that Lipsker renders obvious element 20[d], which requires “selectively cutting the continuous strand before the path of composite material is emitted.” Resp. 32–35. At the outset, it is unclear from the Petition how wire dispenser 19 and cutter 21 depicted in Figures 4C and 4D would have been employed in the Figure 5 embodiment—i.e., whether cutter 28 is moved upstream of nozzle 22 and takes the form of cutter 21, or whether wire dispenser 19 and cutter 21 completely replace Figure 5’s wire dispenser 16 and cutter 28. Pet. 29–31. We address each of these alternatives below.

To the extent Petitioner is arguing that cutter 28 in the Figure 5 embodiment would have been moved upstream of the nozzle and replaced with cutter 21, the Petition does not explain why a person of ordinary skill in the art would have made such a modification. Specifically, it is not clear on this record why a person of ordinary skill in the art would have incorporated the specific cutter embodiment illustrated in Lipsker’s Figures 4B and 4C into Lipsker’s Figure 5 precoating embodiment, because Lipsker’s Figure 5

already has a cutter located downstream from the nozzle that emits the wire precoated with adhesive.¹⁰

Here, we find Petitioner’s reliance on Lipsker’s general statement that “it is appreciated that cutter 28 may be placed in any other suitable location” to be insufficient to meet Petitioner’s burden for at least two reasons.

Pet. 29. First, at best it indicates that a modification could be made, and not what a skilled artisan would have been motivated to make. Such assertions fall short of establishing obviousness. *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015).

Also, it begs the question of whether it would have been “suitable” to locate the cutter depicted in Figures 4B and 4C “upstream of the nozzle” in Figure 5 as alleged by Petitioner. Pet. 30. In order to meet element 20[d], the “continuous strand” (e.g., wire) must be “selectively cut” “before the path of composite material is emitted” from the extruder. Ex. 1001, 12:38–41. For that to happen in Lipsker’s Figure 5 embodiment, it appears that the cutter of Figures 4B and 4C would need to be placed inside the storage receptacle housing wire dispenser 16. *See* Pet. 26 (annotating and color-coding the extruder portion of Lipsker’s precoating embodiment in Figure 5 as immediately preceding nozzle 22). In other words, Petitioner has neither explained nor offered evidence to support its proposition that the cutter depicted in Lipsker’s Figures 4C and 4D could be “suitabl[y] locat[ed]” upstream of the nozzle to selectively cut the wire before the path of composite material is emitted from the extruder, such as in the storage receptacle housing wire dispenser 16.

¹⁰ Petitioner does not address whether this cutter would be eliminated and, if maintained, what its purpose would be.

On the other hand, if we interpret Petitioner’s challenge as proposing the replacement of Figure 5’s wire dispenser 16 and cutter 28 with wire dispenser 19 and cutter 21 from Figures 4C and 4D, Petitioner again fails to sufficiently explain why a person of ordinary skill in the art would have made that substitution. Here, we find Petitioner’s assertion that the skilled artisan “would have understood the wire dispensers [of Figures 4B and 4C] to be embodiments of the wire dispenser 16 of” Figure 5 to be unsupported attorney argument. Reply 8. Neither Petitioner nor Dr. Rosen points to any disclosure within Lipsker that supports this assertion. In fact, Lipsker suggests the opposite because it refers to Figures 4C and 4D as “yet another preferred embodiment” and uses different numerical identification for its wire dispenser (19) as compared to Figure 5 (16). Moreover, wire dispenser 19 contains a “wire cutter 21” that would appear to render Figure 5’s cutter 28 superfluous. Ex. 1006, 4:28–31 (“Wire dispenser 19 is a holding instrument, such as tweezers, tongs or pliers . . . [and] a wire cutter 21 may be provided together with the dispenser 19, for cutting wire 18.”). In short, there is insufficient evidence on this record that supports Petitioner’s assertion that the skilled artisan would have understood the wire dispensers of Lipsker’s Figures 4C and 4D “to be embodiments of the wire dispenser 16” in Lipsker’s Figure 5. Reply 8.

Accordingly, we determine that Petitioner fails to establish that claim 20 would have been obvious over Lipsker.

4. Analysis of Petitioner’s Challenge of Claim 21 over Lipsker

Petitioner’s assertions regarding claim 21 are set forth at pages 31–34 of the Petition. Petitioner again relies on disparate embodiments disclosed within Lipsker to support its assertion that claim 21 would have been

obvious. Pet. 31–34. Specifically, Petitioner relies on Lipsker’s Figure 5 embodiment to satisfy element 21[a], and Lipsker’s Figure 2 embodiment to satisfy elements 21[c] and 21[d]. *Id.*

As with its challenge of claim 20, however, Petitioner provides no motivation to combine the features contained within the disparate Lipsker embodiments necessary to render claim 21 obvious. *Id.*; *KSR*, 550 U.S. at 418; *In re Stepan*, 868 F.3d at 1346 n.1. Without an adequate explanation as to why the ordinarily skilled artisan would have been motivated to combine Lipsker’s separate embodiments, Petitioner has not shown that claim 21 would have been obvious over this reference.

D. GROUNDS 2 & 6 – ALLEGED OBVIOUSNESS OF CLAIMS 1–4, 9–12, 20, AND 21 OVER LIPSKER AND MA

1. Overview of Ma (Ex. 1007)

Ma is a dissertation relating to rapid prototyping and manufacturing technology. Ex. 1007, 7. Ma discloses an “Active Material Supplying” method where “[t]he material is affected by the pressure inside the nozzle that pushes the fluent material out of the orifice.” *Id.* at 53. Ma also discloses a “Passive Material Supplying” method where “the towpreg is pulled out by the object instead of being pushed out by nozzle pressure.” *Id.* at 54.

Ma distinguishes between these two methods, noting that with the “active” method, “[t]he forming quality of a previous layer does not influence the forming of the current layer,” while with the “passive” method, “the quality of a previous layer has a profound effect on the forming quality of the current layer.” *Id.* at 53. Ma sets forth other problems with using the “passive” method. *See, e.g., id.* at 95–96, 98–107, 143, 145–147, 149. For

example, Ma teaches that during deposition using the “passive” method, “it is possible to make a big error, especially when the nozzle makes a big-angle turn” (*id.* at 98), and that “[a] toolpath error could be generated if an anchoring point is not formed properly” when using the “passive” method (*id.* at 143). Ma also discloses that forming speed is an issue with the “passive” method (*id.* at 146), but discloses “[o]ne of the advantages [of the “active” method] is that the forming speed is not limited by the solidification condition of the towpreg during the forming process” (*id.* at 168).

2. *Analysis of Petitioner’s Challenge of Claims 1–4 over Lipsker & Ma*
Claim 1 is reproduced below, along with the limitation identifiers provided by Petitioner.

1. [pre] A method of additively manufacturing a three-dimensional object, the method comprising:
 - [a] emitting from an extruder a path of composite material containing a continuous strand encased in a primary material,
 - [b] the continuous strand being at least one of a wire and a fiber; and
 - [c] moving the extruder during emitting such that the path is pulled out of the extruder during at least a portion of the manufacturing of the three-dimensional object.

Ex. 1001, 10:59–67.

Petitioner’s assertions in Ground 2 regarding claims 1–4 are set forth at pages 34–49 of the Petition. Petitioner advances an additional Ground with respect to dependent claims 3 and 4, i.e., Ground 6, and those assertions are set forth at pages 83 and 84 of the Petition.

a. Ground 2 – claims 1–4

For this Ground, we, like Patent Owner, focus our discussion on Petitioner’s challenge to independent claim 1. Resp. 37–46. Patent Owner

argues, *inter alia*, that “[i]n Ground 2, Petitioner relies on Lipsker’s precoating embodiment of Figure 5 for claim elements 1[a] and 1[b] . . . [, b]ut Petitioner simultaneously also relies on Lipsker’s non-precoating embodiment of Figure 2 for claim element 1[c]” without providing “any reason supported by rational underpinning that a POSITA would have modified or combined teachings from different embodiments of Lipsker to arrive at the claimed subject matter.” *Id.* at 37–38.

We agree with Patent Owner. Petitioner relies at least partially on Lipsker’s disclosure regarding the non-precoating embodiment depicted in Figure 2 to evince the formation of “bonding sites (anchor points)” which, Petitioner alleges, “secure the path and are used to pull the path from the extruder when the latter moves relative to the anchor points.” Pet. 41–42 (citing Ex. 1006, 5:27–29, 5:50–52). These Lipsker citations pertain to Figures 2 and 3, and Petitioner fails to explain how these disclosures would be relevant to Lipsker’s Figure 5 precoating embodiment, if at all. Thus, because Petitioner relies on disparate embodiments within Lipsker to satisfy the limitations of claim 1, but fails to provide a reason to combine those embodiments, Petitioner has not established that the subject matter of claim 1 would have been obvious. *Stepan*, 868 F.3d at 1346 n.1.

Additionally, Petitioner and Patent Owner advance opposing arguments regarding how this challenge of claim 1 is structured in the Petition and Reply. Patent Owner argues that the challenge is a combination of Lipsker and Ma and that Petitioner failed to provide a reason why the skilled artisan would have been motivated to combine these references. Resp. 40–46. Petitioner counters that it “explained that Lipsker discloses all of the actions recited” in claim 1, and that the challenge thus “neither

proffered nor relied on any combination or replacement of the components or steps of operation of Lipsker’s . . . system.” Reply 13. Patent Owner then alleges that Petitioner advanced an improper new theory of obviousness in its Reply. Sur-reply 10–17; *see also* Paper 12, *generally*.

On the complete record, Petitioner has the better position. Although Petitioner indicates that “[t]he combination of Lipsker and Ma discloses each and every limitation of Claim 1” (Pet. 36) and provides a subsection entitled “Motivation to Combine Lipsker and Ma” that includes four separate “reasons” to combine these references (*id.* at 34–36), Petitioner’s challenge of claim 1 sets forth how Lipsker allegedly teaches each of the active steps recited in the claimed method. *See id.* at 37–38 (“Element 1[a] is identical to Element 20[a], which is disclosed by Lipsker in Ground 1”), 39 (making a similar assertion regarding 1[b]). Even though Petitioner characterizes element 1[c] as taught by “Lipsker in combination with Ma,” Petitioner asserts that “Lipsker discloses ‘moving the extruder during emitting’ recited in Element 1[c].” *Id.* at 39. Petitioner also argues that, “[i]n addition, Lipsker discloses that the adhesive forms bonding sites (anchor points) between previously and presently dispensed paths once the adhesive is hardened.” *Id.* at 41. Petitioner relies on Ma, but only to “*explain[]* how anchor points—like the anchor points *disclosed in Lipsker*—secure the path and are used to pull the path from the extruder when the latter moves relative to the anchor points.” *Id.* at 41–42 (emphasis added). Thus, for this challenge of claim 1, Petitioner appears to rely on Ma to explain what Petitioner believes is the natural result of Lipsker forming a

bonding site or “anchor point,”¹¹ i.e., “such that the path is pulled out of the extruder during at least a portion of the manufacturing of the three-dimensional object” as recited in the remainder of element 1[c]. *Id.* at 39–43.¹² Therefore, we disagree with Patent Owner that Ma is solely relied on for this portion of element 1[c]. Resp. 38–39.

To the extent that Petitioner’s challenge could be interpreted to rely solely on Ma for teaching each and every limitation of claim 1,¹³ we determine that Petitioner fails to meet its burden to establish obviousness. Namely, Petitioner’s challenge of claim 1 in Ground 2 also identifies teachings in Ma alone that Petitioner asserts disclose all of the claim limitations. *See* Pet. 36–43. Those specific Ma teachings are insufficient to establish obviousness of the claimed subject matter, however, because Petitioner does not explain persuasively why a person of ordinary skill in the art would have disregarded the numerous teachings in Ma that disparage or

¹¹ Because Petitioner relies on Lipsker’s non-precoating embodiment of Figure 2 to form “bonding sites (anchor points),” we need not, and do not, take a position regarding whether Lipsker’s precoating embodiment of Figure 5 forms a “bonding site” or “anchor point” sufficient to establish the obviousness of claim 1. *See In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380–81 (Fed. Cir. 2016) (rejecting an argument that the Board properly “ma[de] an obviousness argument on behalf of” the petitioner that “could have been included in a properly-drafted petition,” because “petitioner . . . bears the burden of proof” and, thus, the Board “must base its decision on arguments that were advanced by a party, and to which the opposing party was given a chance to respond”) (citations omitted).

¹² We, therefore, do not agree with Patent Owner’s arguments that Petitioner advances a new inherency theory regarding claim 1 in its Reply. Sur-reply 10–17; Paper 12, *generally*.

¹³ *See* Pet. 82 (“Ma discloses each and every limitation of Claim 1, as discussed above in Ground 2.”).

discredit pulling the towpreg from an extruder. Indeed, as Patent Owner points out, Ma describes at least eight disadvantages to using its “passive” method that pulls a towpreg from an extruder. Resp. 20–23, 39–40 (citing Ex. 1007, 53, 95, 96, 98–107, 143–147, 149). Considering that evidence, we credit Patent Owner’s argument that Ma teaches away from the passive pulling method. *Id.* And while Petitioner is correct (Reply 17) that Ma states “[t]he machinery and controlling system for [the passive] method are relatively simple” (Ex. 1007, 84), that teaching is not enough to outweigh the eight other instances within Ma identified by Patent Owner that disparage the passive method. Resp. 20–23, 39–40. Thus, to the extent Petitioner intended to rely solely on the teachings of Ma for claim 1, we determine that Petitioner fails to persuasively demonstrate that claim 1 would have been obvious based on the teachings of Ma alone. Petitioner’s Ground 2 challenge of claims 2–4, which depend from claim 1, fails for the same reasons.

b. Ground 6 – claims 3 and 4

Claim 3 additionally recites “aiming light at the primary material emitting from the extruder to cause the primary material to harden,” and Petitioner relies on its Ground 2 analysis and on Lipsker’s Figure 2 embodiment to disclose that limitation. Pet. 47. Claim 4 recites “moving a source of light with the extruder,” and Petitioner again relies on its Ground 2 analysis and Lipsker’s Figure 6 to disclose this limitation. *Id.* at 48.

Because Petitioner relies on its faulty Ground 2 analysis in its challenge of claim 3 and 4 under Ground 6, Petitioner fails to establish the obviousness of these claims for the same reasons provided with respect to claims 1–4 under Ground 2.

3. *Analysis of Petitioner’s Challenge of Claims 9–12 over Lipsker & Ma*
Claim 9 is reproduced below along with the limitation identifiers provided by Petitioner.

9. [pre] A method of additively manufacturing a three-dimensional object, the method comprising:
[a] emitting from an extruder a path of composite material containing a continuous strand encased in a primary material,
[b] the continuous strand being at least one of a wire and a fiber;
[c] moving the extruder during emitting to generate tension in the path of composite material during at least a portion of the manufacturing of the three-dimensional object; and
[d] hardening the path of composite material to retain the tension in the path of composite material.

Ex. 1001, 11:30–41.

Petitioner’s assertions regarding claims 9–12 are set forth at pages 49–55 of the Petition. Petitioner advances an additional Ground with respect to dependent claims 11 and 12, i.e., Ground 6, and those assertions are set forth at pages 84 and 85 of the Petition.

a. Ground 2 – claims 9–12

Patent Owner argues, *inter alia*, that Petitioner’s challenge of claim 9 is deficient because: (1) it mixes and matches disparate embodiments of Lipsker without providing sufficient motivation to combine those embodiments (Resp. 39–40), (2) it provides insufficient motivation to combine the teachings of Lipsker with Ma (*id.* at 40–46), and (3) it does not establish that step 9[d] is taught in the combination of Lipsker and Ma (*id.* at 46–49). We agree with Patent Owner.

(1) Mixing Lipsker Embodiments

For claim 9, Petitioner references its analysis of claim elements 1[pre], 1[a], 1[b], and 1[c] to evince that Lipsker discloses claim elements

9[pre], 9[a], 9[b], and 9[c], respectively. Pet. 50–51. Such reliance here is infected with the same error as that set forth in Section III.D.2.a., *supra*. Namely, Petitioner relies on Lipsker’s separate non-precoating and precoating embodiments without providing sufficient reasoning why the skilled artisan would have combined those disparate embodiments.

(2) Motivation to Combine Lipsker and Ma

While Petitioner’s challenge of claim 9 relies heavily on the analysis that Petitioner set forth in its challenge of claim 1, claim 9 recites a “hardening” step that claim 1 does not. To satisfy this claim element, Petitioner relies on a combination of Lipsker and Ma. Pet. 52–53. Specifically, Petitioner asserts that Ma’s disclosure of curing the adhesive “as soon as possible” evinces the claimed “hardening the path of composite material to retain the tension” as recited in claim 9. *Id.* at 53. Thus, unlike claim 1, Petitioner relies on the combined teachings of Lipsker and Ma to satisfy the active method steps recited in claim 9.

Petitioner provides four separate rationales why the skilled artisan would have combined Lipsker and Ma:

- 1) each reference is “directed to additive manufacturing methods for forming three-dimensional objects”;
- 2) “Ma complements the work of Lipsker” and “provides additional details about passive material supply methods”;
- 3) Ma’s teachings are readily applicable to Lipsker and would “not require substantial changes or undue experimentation because Ma provides all the necessary experimentation via its dissertation work”; and

- 4) “Lipsker could benefit from Ma’s teachings” because Ma discloses “photo-initiator additives in the adhesive so that cheaper or more readily available light sources (*e.g.*, visible light sources) can be used in place of or together with [ultraviolet (‘UV’)] light sources,” which “would make Lipsker’s disclosed method more economical and flexible.”

Pet. 34–36.

We agree with Patent Owner that these proffered motivations fail to demonstrate that the ordinarily skilled artisan would have combined the teachings of Lipsker and Ma.

As we explained in our Institution Decision (Dec. 15–19), even if we were to agree with Petitioner’s assertion that Lipsker and Ma are in the same field of endeavor, *i.e.*, “additive manufacturing methods for forming three-dimensional objects” (Pet. 34–35), that fact alone would be insufficient to demonstrate that the skilled artisan would have been motivated to combine these references at the time of the invention. Our reviewing court has held that merely asserting that two references are drawn from the same field of art is “simply too conclusory” to show that the skilled artisan would have combined the references in the way of the claimed invention. *Securus Techs., Inc. v. Global Tel*Link Corp.*, 701 F. App’x 971, 976 (Fed. Cir. 2017); *see Microsoft Corp. v. Enfish, LLC*, 662 F. App’x 981, 990 (Fed. Cir. 2016) (determining that “the Board correctly concluded” that a petitioner “did not articulate a sufficient motivation to combine” where the only reason given was “that references were directed to the same art or same techniques”). Thus, the question of whether the prior art references are in the same field of endeavor is merely a threshold issue that must be satisfied

before an obviousness determination can be made. *See K-TEC, Inc. v. Vita-Mix, Corp.*, 696 F.3d 1364, 1375 (Fed. Cir. 2012) (to qualify as prior art in an obviousness analysis, references must be analogous art—either in the same field of endeavor or reasonably pertinent to the problem with which the inventor is involved). In other words, once it is determined that the prior art is analogous to the claimed invention, it is then necessary to show that it would have been obvious for the skilled artisan to select and combine the teachings of the prior art in the manner claimed.

To establish obviousness, the Petition needs to set forth specific reasoning as to why the skilled artisan would have been motivated to combine Lipsker and Ma even if they are in the same or similar fields, and Petitioner fails to do so on the complete record.

Petitioner's second reason to combine these references fares no better than the first because it, too, relies on Ma's "passive material supply mechanism in which a towpreg is pulled out from the extruder instead of being pushed out from the extruder." Pet. 35. Even if we were to overlook Petitioner's lack of explanation regarding Ma's consistent teaching away from the passive supply method, Petitioner provides a single generic citation to one page of Ma—an exhibit that spans 248 pages—with no detailed explanation regarding how Ma's teachings would have enlightened the skilled artisan's understanding of Lipsker such that the skilled artisan would have arrived at the claimed subject matter. *Id.*

Petitioner's third reason to combine is similarly deficient because it fails to address the teachings of Lipsker and Ma with any degree of specificity and again does not elaborate on how or why the skilled artisan would have combined the teachings of these references to arrive at the

claimed subject matter. *Id.* Instead, Petitioner appears to be arguing that a skilled artisan could have combined unspecified teachings of Ma in unspecified ways to improve Lipsker’s method. However, “obviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of [the] prior art to arrive at the claimed invention.” *Belden*, 805 F.3d at 1073.

Petitioner’s fourth reason also lacks sufficient specificity and fails to provide any evidentiary support for the proposition that Ma’s photo-initiator additives, if present in the adhesive, would allow for “cheaper and more readily available light sources” to be used “in place of or together with UV light sources.” Pet. 35–36. Thus, Petitioner’s statement is nothing more than an unsupported conclusory assertion regarding a possible benefit.

Assertions such as these fall short of providing the requisite rationale sufficient to support a conclusion of obviousness. *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (*cited with approval in KSR*, 550 US at 418).

Additionally, “[a]ttorneys’ argument is no substitute for evidence.”

Johnston v. IVAC Corp., 885 F.2d 1574, 1581 (Fed. Cir. 1989).

In sum, Petitioner fails to provide the requisite motivation to combine the applied prior art. Thus, Petitioner fails to establish that claim 9 would have been obvious.

(3) The “hardening” step of 9[d]

Step 9[d] recites “hardening the path of composite material to retain the tension in the path of composite material.” Ex. 1001, 20. To evince this limitation, Petitioner relies on Ma’s disclosure of curing the adhesive “as soon as possible.” Pet. 53 (citing Ex. 1007, 57).¹⁴

¹⁴ Petitioner cites to the native page number of Ma (i.e., page 41) rather than

Patent Owner argues that Ma’s disclosure that the hardening occurs “as soon as possible” does not necessarily mean that tension is retained in the composite material. Resp. 46–48. We agree. Petitioner does not explain, nor do we discern, how Ma’s hardening “as soon as possible” would necessarily equate to tension being retained in the composite path. As correctly pointed out by Patent Owner, Ma’s curing timeframe of “as soon as possible” “may not be soon enough to retain tension in the towpreg—the tension could simply be released before hardening finishes.” *Id.* at 48.

For this additional reason, Petitioner’s challenge of claim 9 fails. Petitioner’s Ground 2 challenge as to claims 10–12, which depend from claim 9, is deficient for the reasons discussed *supra* for claim 9.

b. Ground 6 – claims 11 and 12

In its analysis of claim 11 for Ground 6, Petitioner argues that “Claim 11 is substantially similar to claim 3” and relies on its analysis pertaining to claim 3 in Ground 6 to satisfy this limitation, which in turn relies on the faulty analysis provided in Ground 2. Pet. 45, 83–84. Similarly, to support its challenge to claim 12 under Ground 6, Petitioner argues that “Claim 12 is identical to Claim 4” and relies on its assertions with respect to claim 4 in Ground 6, which in turn relies on its assertions regarding claim 4 in Ground 2. *Id.* at 84–85.

Because Petitioner relies on its faulty Ground 2 analysis in its challenge of claim 11 and 12 under Ground 6, Petitioner fails to establish the obviousness of these claims for the same reasons provided with respect to claims 9–12 under Ground 2.

the page number of the Exhibit where the referenced disclosure appears (i.e., page 57). We refer to the Exhibit page.

4. *Analysis of Petitioner’s Challenges of Claim 20 over Lipsker & Ma*

Petitioner’s challenges of claim 20 are set forth at pages 55–56 of the Petition for Ground 2 and at pages 85–86 of the Petition for Ground 6.

Relevant to our disposition of these challenges, Petitioner references its analysis of claim element 20[d] set forth in Ground 1, i.e., its challenge of claim 20 over Lipsker alone. *See* Pet. 56, 86 (stating for each of Grounds 2 and 6 that the combination of Lipsker and Ma “discloses Element 20[d] for at least the same reasons Lipsker discloses Element 20[d] in Ground 1”).

We found Petitioner’s challenge to claim 20 over Lipsker alone to be insufficient to establish obviousness, partly because Petitioner does not establish that Lipsker renders obvious element 20[d], the selective cutting step. *See* Section III.C.3.b., *supra*. That analysis applies equally here in view of Petitioner’s reliance on Lipsker to evince the obviousness of that claimed method step. Pet. 56.

5. *Petitioner’s Challenge of Claim 21 over Lipsker and Ma*

Petitioner’s challenge of claim 21 is set forth at pages 57–60 of the Petition for this Ground. Petitioner asserts that Lipsker and Ma, alone and in combination, disclose each limitation of claim 21. Pet. 57–60.

This challenge can be understood three ways, each of which fails to demonstrate the obviousness of claim 21 on the complete record. Specifically, if this challenge is viewed as being based on the teachings of Lipsker alone, it fails because it mixes and matches the disparate precoating and non-precoating embodiments of Lipsker. *See* Pet. 57 (referencing the Ground 1 analysis for elements 21[pre], 21[a], and 21[b], which Petitioner states are “identical to Elements 1[pre], [a], and [b],” which relies on Lipsker’s precoating embodiment, and referencing the Ground 1 analysis for

element 21[c], which relies on Lipsker's non-precoating embodiment). Such reliance here is unpersuasive for the same reasons provided in our Ground 1 analysis. *KSR*, 550 U.S. at 418; *Stepan*, 868 F.3d at 1346 n.1.

If we interpret Petitioner's challenge to be based on Ma alone, that also fails because it relies on Ma's passive method of extrusion that Ma repeatedly disparages and teaches against. Thus, our analysis as provided in Section III.D.2.a. regarding Ma's teaching away applies equally here.

And, finally, if we interpret Petitioner's challenge as being based on the combination of Ma and Lipsker, that, too, is insufficient to establish obviousness because Petitioner relies on the same deficient reasons to combine the Lipsker and Ma references as discussed in Section III.D.3.a.2.

Thus, on the complete record, Petitioner has not shown that claim 21 would have been obvious over Lipsker and Ma, either alone or in combination.

E. GROUND 3 – ALLEGED OBVIOUSNESS OF CLAIMS 5–8 OVER LIPSKER & CRUMP

1. The Challenged Claims

Claim 5 is illustrative of these challenged claims and is reproduced below along with the limitation identifiers provided by Petitioner.

5. [pre] A method of additively manufacturing a three-dimensional object, the method comprising:

[a] emitting from an extruder a path of composite material containing a continuous strand encased in a primary material,

[b] the continuous strand being at least one of a wire and a fiber;

[c] moving the extruder during emitting such that the path of composite material extends from an anchor through free space during at least a portion of the manufacturing of the three-dimensional object; and

[d] hardening the path at a fixed location in three-dimensional space without support between the anchor and the extruder.

Ex. 1001, 11:9–21.

2. Overview of Crump (Ex. 1008)

Crump discloses an “[a]pparatus incorporating a movable dispensing head provided with a supply of material which solidifies at a predetermined temperature, and a base member, which are moved relative to each other along ‘X,’ ‘Y,’ and ‘Z’ axes in a predetermined pattern to create three-dimensional objects.” Ex. 1008, code (57).

Crump discloses an embodiment in Figure 12 where “wire frame objects comprised of multiple, free-standing strands 180 defining wire frame segments 180a and 180b could be formed.” *Id.* at 15:21–26. Figure 12 is reproduced below:

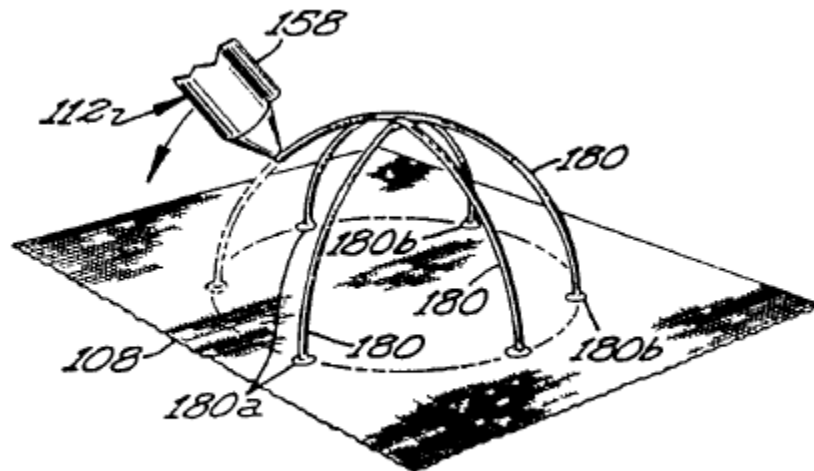


Fig 12

Crump’s Figure 12 embodiment depicts forming strands 180 in an arcuate shape spanning from anchor points 180a and 180b. *Id.* at 15:22–32. Crump teaches that “the strands are anchored at two points and also to each other where they intersect.” *Id.* at 15:38–39.

3. *Analysis of Petitioner’s Challenge of Claims 5–8 over Lipsker and Crump*

Petitioner relies on the combined teachings of Lipsker and Crump to teach the limitations of claim 5. Pet. 62–67.

Patent Owner argues, *inter alia*, that Petitioner does not provide a sufficient rationale to establish that a person of ordinary skill in the art would have been motivated to combine the teachings of Lipsker and Crump. Resp. 50–54.

We agree with Patent Owner. Petitioner provides three reasons to combine the teachings of Lipsker and Crump. Pet. 60–61. According to Petitioner, “Lipsker and Crump are directed to methods for additively manufacturing three-dimensional objects.” *Id.* at 60. That contention is insufficient to establish a motivation to combine Lipsker and Crump because merely asserting that two references are drawn from the same field of art is “simply too conclusory” to show that the skilled artisan would have combined the references in the way of the claimed invention. *Securus Techs.*, 701 F. App’x at 976; *see Microsoft*, 662 F. App’x at 990 (determining that “the Board correctly concluded” that a petitioner “did not articulate a sufficient motivation to combine” where the only reason given was “that references were directed to the same art or same techniques”). The question of whether the prior art references are in the same field of endeavor is merely a jumping-off point in the determination of whether a claimed invention is obvious. *See K-TEC, Inc.*, 696 F.3d at 1375 (to qualify as prior art in an obviousness analysis, references must be analogous art—either in the same field of endeavor or reasonably pertinent to the problem with which the inventor is involved). Thus, even assuming the references are analogous art, it is still necessary to show that it would have been

obvious to a POSITA to select and combine the teachings of those references in the manner claimed.

Petitioner’s second proffered rationale—that “Lipsker could benefit from Crump’s disclosure” (Pet. 61)—is also insufficient. Petitioner asserts that Lipsker in view of Crump “can identify adhesive materials that solidify instantly upon emission from the extruder and exposure to UV-light to form free-standing structures with or without the incorporation of a wire.” *Id.* As we found in our Institution Decision, however, Lipsker already discloses quick-curing adhesives (Ex. 1006, 3:32), and Petitioner does not explain why the skilled artisan would have been motivated to modify or substitute Lipsker’s quick-curing adhesive in favor of a particular adhesive disclosed in Crump. Dec. 21–22. Thus, it is not evident on the complete record whether or how Lipsker’s process would have benefitted from Petitioner’s proposed modification.

On this point, we reject Petitioner’s argument that this challenge “neither proposed nor relied on any combination or replacement of the components or operations of Lipsker’s, Ma’s, or Crump’s systems, and does not suggest or require any modification of these systems.” Reply 24. Here, we observe that Petitioner frames the challenge as based on a combination of only Lipsker and Crump. Pet. 60–67. Moreover, for elements 5[c] and 5[d], Petitioner relies specifically on that combination, asserting that Crump’s Figure 12 illustrates a scenario where strand 180 is free-standing between anchor points 180a and 180b, and that “[a]ccording to Crump, the extruded liquid material solidifies instantly when exposed to the ambient temperature or to a coolant.” *Id.* at 65–66 (citing Ex. 1008, 15:21–51) (emphasis added). Notably, Petitioner asserts that the ordinarily skilled artisan “would have

understood ‘hardening the path at a fixed location in three-dimensional space without support . . .’ is achieved via the appropriate selection of the adhesive material (*as taught by Crump*) that solidifies immediately after emission from the extruder.” *Id.* at 67 (emphasis added); *see also id.* at 61 (noting that the skilled artisan could use *Lipsker’s apparatus* “but make a proper selection of an adhesive that hardens instantaneously” and asserting that “the adhesive could be a solid, such as the solid rod or flexible strand *described by Crump*”) (emphases added). Significantly, for elements 5[c] and 5[d], Petitioner does not rely on Lipsker’s disclosure of fast-curing adhesives, but instead relies solely on Crump’s teachings regarding selecting the appropriate adhesive. *Id.* at 61, 64–67. Thus, on the complete record, we are not persuaded that Petitioner relies on Crump solely to describe an effect achieved by Lipsker’s extruder (Reply 24), but rather determine that Petitioner relied on the combined teachings of these references to satisfy claim 5’s limitations. Under these circumstances, Petitioner must provide an adequate rationale to combine the teachings of Lipsker and Crump to establish the obviousness of claim 5 and its dependent claims, which Petitioner fails to do.

Petitioner’s final proffered motivation to combine Lipsker and Crump is that “applying the teachings of Crump to Lipsker does not require substantial changes or modifications.” Pet. 61. That reason is insufficient because it fails to address the teachings of Lipsker and Crump with enough specificity, and again does not elaborate on how or why the skilled artisan would have combined the teachings of these references to arrive at the claimed subject matter. *Id.* However, “obviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to*

make the combinations or modifications of [the] prior art to arrive at the claimed invention.” *Belden*, 805 F.3d at 1073. There is insufficient evidence on the complete record to establish that the skilled artisan would have been so motivated.

Thus, Petitioner fails to satisfy its burden that claim 5—and by extension, its dependent claims 6–8—would have been obvious over the combined disclosures of Lipsker and Crump.

F. GROUNDS 7 & 8 – ALLEGED OBVIOUSNESS OF CLAIMS 5 & 6 OVER MA & CRUMP, AND CLAIMS 7 & 8 OVER MA, CRUMP, & LIPSKER

1. Analysis of Ground 7

Petitioner relies on the combined teachings of Ma and Crump to teach the limitations of claim 5. Pet. 88–91.

Patent Owner argues that Petitioner does not provide reasoning sufficient to establish that a person of ordinary skill in the art would have been motivated to combine the teachings of Ma and Crump. Resp. 62–64. Patent Owner also argues that Ma disparages its passive method, which is relied on in Petitioner’s challenge. We agree with both of Patent Owner’s arguments.

For this Ground, Petitioner provides similar motivations to combine the references that we have already found insufficient (Pet. 87–88), and we find these proffered motivations deficient here for similar reasons. For example, Petitioner again asserts that the references are in the same field of additive manufacturing of three-dimensional objects. *Id.* at 87. Even if true, that is not enough to establish that a skilled artisan would have been motivated to combine those references’ teachings. *Securus Techs.*, 701 F. App’x at 976; *Microsoft*, 662 F. App’x at 990. Petitioner also provides a

vague and generic assertion that the skilled artisan “would have found that Crump introduces additional methods and material considerations,” without detailing precisely what those methods and materials would be. Pet. 87. Notably, and as Petitioner acknowledges, Ma already discloses that the “towpreg is heated or is exposed to energy . . . and is quickly solidified and allowed to adhere to the previous layer,” and that “[a]ll the deposition and adhering procedures for a towpreg segment could be finished in a short time (0.01-0.1 Second).” *Id.*; Ex. 1007, 58–60.¹⁵ Thus, it is unclear on the complete record why the skilled artisan would have been motivated to consult Crump’s disclosure regarding specific adhesives.

We again reject Petitioner’s argument that it “neither proposed nor relied on any combination or replacement of the components or operations of Lipsker’s, Ma’s, or Crump’s systems, and does not suggest or require any modification of these systems.” Reply 24. Petitioner frames this challenge of claim 5 as a combination of Ma and Crump. Pet. 86–91. Moreover, Petitioner relies solely on Crump for a portion of 5[c] and a portion of 5[d]. *See id.* at 90, 91 (identifying the portions of these limitations for which Crump was relied on to “disclose[]”). Under these circumstances, Petitioner must provide sufficient reasoning why the skilled artisan would have combined Ma and Crump, which Petitioner fails to do.

And for the same reasons we provided in Section III.D.2.a., *supra*, we determine that Petitioner does not persuasively address Ma’s numerous teachings that disparage or discredit its passive extrusion method. Ma’s identification of one mere possible advantage to the passive method

¹⁵ As noted above, unlike Petitioner, we cite to the Exhibit page numbers, not the native page numbers of the Ma thesis. Pet. 87.

(Ex. 1007, 84) is insufficient to outweigh the eight portions of Ma that discredit this method. Ex. 1007, 53, 95, 96, 98–107, 143–147, 149.

2. *Analysis of Ground 8*

This challenge is directed to claims 7 and 8, which depend from claim 5. For this challenge, Petitioner relies in part on its insufficient reasons to combine Ma and Crump as set forth in Ground 7, *supra*, as well as Ma’s passive extrusion method. Pet. 92–94. As a result, this challenge inherits the same deficiencies that we set forth in our analysis of Ground 7, which need not be repeated here.

G. GROUND 5 – ALLEGED OBVIOUSNESS OF CLAIMS 1, 2, 9, 10, AND 21 OVER MA

1. *Analysis of Petitioner’s Challenge of Claims 1 & 2*

For its challenge of claims 1 and 2 under this Ground, Petitioner refers back to its analysis of claims 1 and 2 under Ground 2. Pet. 82. The challenge fails here for the same reasons we provided in our analysis in Section III.D.2.a. for claims 1 and 2 under Ground 2.

2. *Analysis of Petitioner’s Challenge of Claims 9 & 10*

Similar to claims 1 and 2, Petitioner relies on its Ground 2 analysis for claims 9 and 10. Pet. 82. But, as we found with respect to claim 9 in Ground 2, Ma fails to render obvious element 9[d]. *See* Section III.D.3.a.3 *supra*. Thus, Petitioner’s challenge of claims 9 and 10 in Ground 5 fails for the same reasons it did in Ground 2.

3. *Analysis of Petitioner’s Challenge of Claim 21*

Referring to its Ground 2 analysis, Petitioner asserts that “Ma discloses each and every limitation of Claim 21.” Pet. 83. Turning to that analysis, Petitioner details where it believes Ma individually discloses each of the elements 21[pre], 21[a], 21[b], 21[c], and 21[d]. *Id.* at 57–60.

Petitioner acknowledges that it “relies solely on Ma’s pulling embodiment” in this challenge. Reply 26.

Patent Owner argues—after pointing out Petitioner’s reliance on Ma’s disparaged passive method—that for element 21[c], “Petitioner relies on the toolpath error exhibited by Ma’s self-anchoring method.” Resp. 61. Thus, we understand Patent Owner’s argument here to be that Petitioner does not demonstrate why a person of ordinary skill in the art would have selected Ma’s passive method, which includes self-anchoring a towpreg,¹⁶ in view of Ma’s multiple teachings away from the passive method. We agree with Patent Owner.

As we set forth in Section III.D.2.a., Ma teaches away from the passive pulling method. And while we recognize that claim 21 does not *per se* require self-anchoring or pulling a composite material, Petitioner’s challenge is based on teachings within Ma that are tied to that disparaged passive method. *See* Pet. 83 (“Ma discloses each and every limitation of Claim 21, as discussed above in Ground 2.”). Thus, although there may be teachings within Ma that satisfy element 21[c] without relying on the passive “pulling” method, we must base our decision on the challenge that Petitioner presents to us. *Magnum Oil*, 829 F.3d at 1380–81. On this record, we are not persuaded that the skilled artisan would have disregarded the eight instances within Ma identified by Patent Owner that teach away from the passive method. Ex. 1007, 53, 95, 96, 98–107, 143–147, 149; Resp. 20–23.

¹⁶ *See* Ex. 1007, 140 (identifying “[t]he self-anchoring method [as] a Passive Materials Supply Method”).

IV. CONCLUSION

For these reasons, Petitioner does not establish by a preponderance of the evidence that claims 1–12, 20, or 21 of the ’708 patent are unpatentable.

We summarize our decision in the following chart:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
20, 21	103(a)	Lipsker		20, 21
1–4, 9– 12, 20, 21	103(a)	Lipsker, Ma		1–4, 9–12, 20, 21
5–8	103(a)	Lipsker, Crump		5–8
13–19	103(a)	Lipsker, Nikzad ¹⁷		
1, 2, 9, 10, 21	103(a)	Ma		1, 2, 9, 10, 21
3, 4, 11, 12, 20	103(a)	Ma, Lipsker		3, 4, 11, 12, 20
5, 6	103(a)	Ma, Crump		5, 6
7, 8	103(a)	Ma, Crump, Lipsker		7, 8
13, 14	103(a)	Ma, Nikzad ¹⁸		
15–19	103(a)	Ma, Nikzad, Lipsker ¹⁹		
Overall Outcome				1–12, 20, 21

¹⁷ We do not reach this challenge in view of Patent Owner’s statutory disclaimer of claims 13–19.

¹⁸ We do not reach this challenge in view of Patent Owner’s statutory disclaimer of claims 13–19.

¹⁹ We do not reach this challenge in view of Patent Owner’s statutory disclaimer of claims 13–19.

V. ORDER

It is hereby:

ORDERED that claims 1–12, 20, and 21 of the '708 patent have not been proven by a preponderance of the evidence to be unpatentable; and

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.

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