UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MARKFORGED INC.,
Petitioner,

v.

CONTINUOUS COMPOSITES, INC.,
Patent Owner

CASE NO. IPR2022-00679

U.S. Patent No. 10,744,708

Issue Date: August 18, 2020

Title: METHOD AND APPARATUS FOR CONTINUOUS COMPOSITE THREE-DIMENSIONAL PRINTING

DECLARATION OF DAVID ROSEN, PH.D. IN SUPPORT OF PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE IN *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,744,708

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I, David Rosen, Ph.D., declare as follows:

I. SUMMARY OF REPLY

1. I have reviewed Patent Owner's Response ("POR"). In my opinion, Patent Owner ("PO") has made several erroneous arguments. In this declaration, I explain these errors, citing relevant prior art references. In addition to the materials I considered in my Declaration in support of the Petition ("Petition-Declaration"), I considered the materials that are listed below:

Exhibit No.	Exhibit[1]
1018	*Markforged Inc. v. Continuous Composites, Inc.* IPR2022-00548, Decision Denying Institution of *Inter Partes* Review
1019	*Markforged Inc .v. Continuous Composites, Inc.* IPR2022-00732, Decision Denying Institution of *Inter Partes* Review
1020	*Markforged Inc. v. Continuous Composites, Inc.* IPR2022-01218, Decision Denying Institution of *Inter Partes* Review
1021	*Markforged Inc. v. Continuous Composites, Inc.* IPR2022-01220, Decision Denying Institution of *Inter Partes* Review
1022	*Markforged Inc. v. Continuous Composites, Inc.* IPR2022-01431, Decision Denying Institution of *Inter Partes* Review
1023	*Markforged Inc. v. Continuous Composites, Inc.* C.A. No. 21-990 (MN), Memorandum Order (March 17, 2023)

[1] In citations, emphasis is added unless noted otherwise.

Exhibit No.	Exhibit[1]
1024	The Free High School Science Texts: A Textbook for High School Students Studying Physics (2005), http://www.nongnu.org/fhsst/fhsstphy.pdf
1025	C.T. Crowe, D.F. Elger, B.C. Williams, and J.A. Roberson, Engineering Fluid Mechanics (9th ed., John Wiley & Sons, Inc. 2009) (excerpt)

The following is a summary of my explanations. As explained in my Petition-Declaration, the challenged claims are invalid as obvious in light of the prior art, e.g., over Lipsker and Ma individually, and over various combinations discussing in the Petition-Declaration. In rebuttal, Patent Owner ("PO") presents three main arguments: (i) petitioner does not provide a motivation to combine Lipsker's two different embodiments; (ii) Ma disparages the pulling method and hence would not be combined with other references; and (iii) petitioner does not provide a motivation to combine Crump with other references.

2. As explained in details in the following sections, each of PO's arguments is erroneous. First, the Petition-Declaration does not propose and does not rely on a combination of Lipsker's two different embodiments. Second, Ma does not disparage pulling, and regardless, the combination with Ma is proffered only to show the known pulling effect of the steps performed in other references.

The Petition-Declaration does not propose and does not rely on any modification of those references according to Ma. Likewise, the combination with Crump is proffered only to show the known effect of forming free-standing three-dimensional structures resulting from the steps performed in other references. The Petition-Declaration does not propose and does not rely on any modification of those references according to Crump.

II. EACH CHALLENGED GROUND RENDERS THE RESPECTIVE CLAIMS CHALLENGED UNDER THAT GROUND OBVIOUS

3. Each of the Grounds 1-10 renders the claims challenged under the respective Ground obvious. *See generally*, Ex.1002. PO states that the Board did not find a reasonable likelihood of success for grounds 2, 3, and 5-10. POR at 1-6. Additionally, PO alleges that institutions of various other IPRs for the patents in the family of the '708 patent have been denied. *Id*. at 6.

4. The Board's decisions regarding Grounds 2, 3, and 5-10, and in other IPRs appear to be generally based on the Board's observation that Ma (Ex.1007) appears to disparage a passive pulling of the composite material used to form three-dimensional objects, and prefers instead, an active, pushing method. *See* Institution Decision at 17-18; *see also*, Ex.1018 at 18-19; Ex.1019 at 18-19; Ex.1020 at 9; Ex.1021 at 9-10; Ex.1022 at 19. Based on this observation, the Board found that Ma by itself does not render the challenged claims obvious, and

that Petitioner did not provide adequate motivation to combine Ma with other references in the proposed combinations. *See* Institution Decision at 18-19.

5. I have addressed these concerns below.

III. CLAIM CONSTRUCTION

A. "Anchor"

6. In my Petition-Declaration, I did not offer any particular construction of the term "anchor" that claim 5 of the '708 patent recites. I pointed out, however, that with reference to its FIG. 9, the '708 patent describes an "anchor" as "[a]ny surface or point" and that the "origin of the path adheres to the anchor." Ex.1002, ¶46. The process of forming a three-dimensional object often includes several steps of depositing a composite material. For example, the '708 patent states:

> A part may be constructed of one continuous path or may be formed from several paths. FIG. 2 shows a sectional view of a simple part with multiple paths. When constructing a part, **each path is extruded sequentially**. The first path is extruded and cut, and then **another path** is extruded and cut, **connecting to some portion of the previous path**. Additional paths are extruded until the entire part is formed.

Ex.1001, 6:37-43, FIG. 2; *see id.*, 2:39-40 (stating that "[e]ach path is one continuous extrusion of the composite material").

7. Thus, according to the '708 patent, any surface or point can serve as an anchor for the first path, and a surface of a previous path, or a point thereon, may serve as an anchor for the next path. In my opinion, the plain and ordinary meaning of "anchor" that is proposed in the Petition, *see* Pet. at 12, is consistent with the above-noted description of an anchor in the '708 patent. Moreover, Lipsker, Ma, and Crump each disclose one or more anchors according to the plain and ordinary meaning of that term. *See id*. at 40-42, 58, 65; Ex.1002, ¶¶136-141 (discussing Lipsker's and Ma's anchor points), 208-209 (discussing Crump's anchor points)

8. Patent Owner ("PO") construes "anchor" as "contact to which the path of composite material is adhered to enable pulling of the path." POR at 15. I am informed and understand that in the on-going parallel litigation, the Court has construed the terms "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.'" Ex.1023 at 2. I am also informed and understand that in its decision to deny institution of *inter partes* review of a related patent, the Board states that "an anchor point is a contact point to which the fiber is affixed and that serves as an origin point." Ex.1018 at 12. I explain below that Lipsker, Ma, and Crump each teaches an "anchor" according to PO's construction in the POR, and also according

to the Court's and Board's constructions. *See below*, § VI(A).

IV. GROUND 1: LIPSKER TEACHES ALL ELEMENTS OF CLAIMS 20 AND 21

A. A POSITA Would Have Known that the Individual *Teachings* of Lipsker's Precoating and Non-precoating Embodiments Are Not Limited to the Specific Embodiments But Apply to Both

9. As I explained in my Petition-Declaration, Lipsker discloses all of the elements of claims 20 and 21. Ex.1002, ¶¶90-120; Pet. at 23-34. PO alleges that to show all of the elements of claim 20, Petitioner combines Lipsker's two different embodiments without providing the motivation for such a combination. POR at 28-30. Specifically, PO characterizes Lipsker's embodiments described referring to FIGS. 2 and 5 as a non-precoating actuator embodiment and a pre-coating actuator embodiment, respectively. *Id*. at 28. Thereafter, PO alleges that while relying on both of these embodiments for claim 20, Petitioner does not provide a motivation to combine the two embodiments. *Id*. at 28-32. PO's argument fails because, as discussed below, to show all of the elements of claims 20 and 21, it is not necessary to combine the two embodiments of Lipsker, and no such combination is proffered in the Petition or in my Petition-Declaration.

10. The Petition-Declaration refers to Lipsker's FIG. 5 because Lipsker describes the feature of emitting "a path of composite material" recited in claims 20 and 21 referring to FIG. 5. Ex.1002, ¶¶95-100, 113 (citing Ex.1006, 2:14-17,

5:53-59, FIG. 5); *see* Pet at 25-27 and 31. The composite material includes a wire and an adhesive. Ex.1002, ¶¶95-100. The Petition-Declaration also refers to FIG. 2 because Lipsker discloses the feature "hardening the path" recited in claims 20 and 21 referring to FIG. 2. Ex.1002, ¶¶104-108, 118-119 (citing Ex.1006, 2:51-57, 5:28-32, FIG. 2); *see* Pet at 28-29, 33-34. In particular, the "hardening [of] the path" occurs when the adhesive is cured and is thus hardened. Ex.1002, ¶107.

11. As a threshold matter, Lipsker states explicitly that "[i]t is appreciated that various **features of the invention** which are, for clarity, **described in** the contexts of **separate embodiments may also be provided in combination in a single embodiment**." Ex.1006, 6:56-59. Therefore, Lipsker discloses, and a POSITA would have understood, that the feature of curing/hardening the adhesive that is described while discussing the non-precoating embodiment of FIG. 2 can also be provided in the pre-coating embodiment of FIG. 5.

12. Moreover, even though Lipsker explicitly discusses curing of the adhesive in connection with FIG. 2 only (the non-precoating embodiment), a POSITA would have understood that curing is a treatment of the dispensed adhesive that can be performed regardless of whether it is dispensed separately from a wire or while precoating the wire, and that such curing would have the effect of hardening the adhesive in both cases. Accordingly, a POSITA would

have understood that performing curing of the adhesive, when it precoats the wire as described referring to FIG. 5, and the resulting hardening of the composite material having the cured adhesive, does not require a combination of the non-precoating (FIG. 2) and precoating (FIG. 5) embodiments.

13. The reason why the Petition cites the descriptions of FIGS. 2 and 5 both is that Lipsker describes curing of the adhesive in discussing FIG. 2, and does not repeat that description in discussing FIG. 5, which discloses extruding a composite material having a wire and an adhesive. *Id*., 5:23-31, 5:53-60, FIGS. 2 and 5. But, a POSITA would have understood that uncured adhesive and a wire, regardless of whether extruded together or separately, can be shaped in any desired manner, and thus, their combination can be used to create an intended object. *See, e.g.*, *id.*, 2:50-59 (disclosing that layers of wire may be dispensed "in accordance with the geometry of an object" and that the adhesive is applied "so as to bond" the successive layers of wire), 5:24-32, FIG. 2.

14. Additionally, a POSITA would have understood that regardless of whether the adhesive is dispensed separately from or together with the wire, subsequent curing of the extruded adhesive is needed so as to form a **hardened** object, i.e., cured adhesive together with the embedded solid wire. *See, e.g.*, *id*., 2:39-44 (disclosing "dispensing layers of an adhesive" and "curing the layers to

form a prototype of the object"), 2:50-59 (disclosing "curing the adhesive so that the layers of wire form a prototype of the object"), 5:30-32.

15. A POSITA would have further understood that hardening by curing is a property of Lipsker's adhesive, regardless of whether it is used to precoat the wire or is dispensed separately. *Id*., 6:4-9 (stating that "engineering and design parameters such as . . . bonding and curing characteristics of the adhesive, should be carefully chosen in order that" adhesive layers bond and cure, i.e., harden, properly). Finally, a POSITA would have also understood these to be the reasons why Lipsker does not repeat the discussion of curing the adhesive, provided earlier in discussing FIG. 2, while describing FIG. 5. *Id*.

16. Specifically, a POSITA would have known that Lipsker's adhesive would be cured and hardened when extruded separately from the wire, and also when extruded together with the wire forming a composite material. Therefore, a combination of Lipsker's non-precoating (FIG. 2) and precoating (FIG. 5) embodiments is wholly unnecessary, and the Petition-Declaration neither proposes nor relies on such a combination. Lipsker thus teaches all of the elements of claims 20 and 21, as explained in the Petition-Declaration. Ex.1002, ¶¶90-120; Pet. at 23-34.

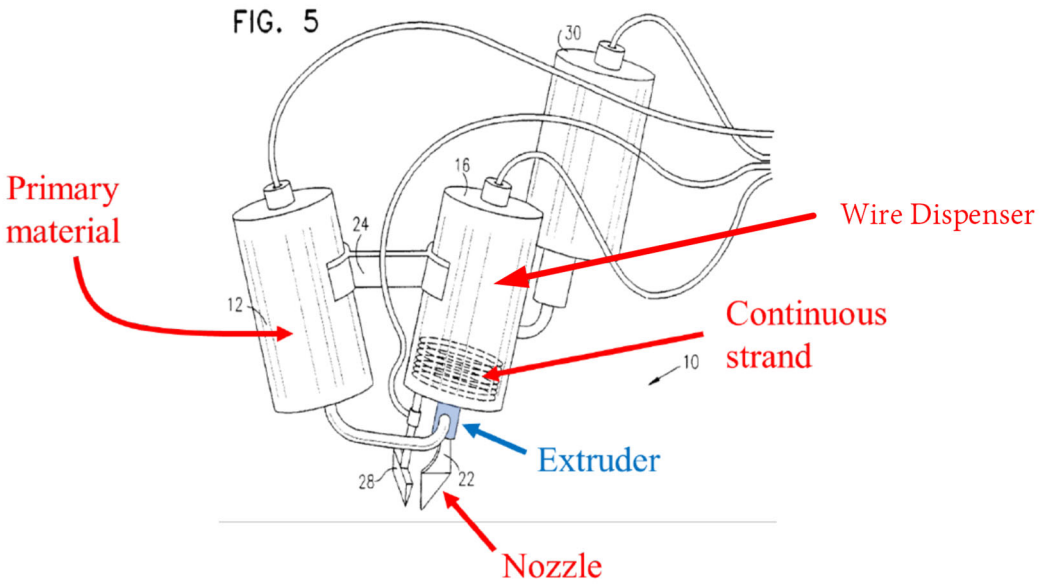
B. Lipsker Teaches Cutting Wire Before Adhesive Is Dispensed As Required by Claim 20

17. Claim element 20[d] recites "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." Lipsker teaches this limitation. Ex.1002, ¶¶110-111 (citing Ex.1006, 3:47-49, 4:56-59, 5:61-67, FIGS. 4A, 4C, and 4D); Pet. at 29-31. PO alleges that Lipsker discloses "cutting wire 18 *after*, not *before*, emitting from the extruder." POR at 32 (emphasis in original). PO's allegation is incorrect, as I explain below.

18. In the non-precoating embodiment of FIG. 2, "[c]utter 28 is illustrated disposed **intermediate** adhesive dispenser 12 and wire dispenser 16." Ex.1006, 4:56-59. Since the cutter is "intermediate," i.e., the adhesive dispenser is downstream from the cutter 28, the embodiment of FIG. 2 teaches cutting the wire before the emission of the adhesive.

19. In the precoating embodiment of FIG. 5,[2] the wire dispenser 16 is upstream of nozzle 22. Ex.1006, FIG. 5.

[2] The wire dispenser 16 is upstream of the nozzle 22 in the non-precoating embodiment of FIG. 2, as well.



Ex.1006, FIG. 5 (annotated); *see* Ex.1002, ¶97 (reproducing an identically annotated FIG. 5 except for the annotation of the wire dispenser 16); Pet. at 26.

20. In discussing claim element 20[d], the Petition-Declaration refers to certain embodiments of the wire dispenser that are depicted and described with reference to FIGS. 4A, 4C, and 4D. Ex.1002, ¶¶110-111; *see* Pet. at 29-31. A POSITA would have understood the wire dispensers of FIGS. 4A, 4C, and 4D to be embodiments of the wire dispenser 16 of FIG. 5. A POSITA would have further recognized that because the wire dispenser 16 is upstream of the nozzle 22, and because FIGS. 4A, 4C, and 4D illustrate different wire dispenser embodiments, any of which can be the wire dispenser 16 of FIG. 5, such a wire dispenser would be disposed upstream of the nozzle 22. My Petition-Declaration states so explicitly. Ex.1002, ¶111 (stating that a "POSITA would have understood

that wire dispenser 1[6] shown in Figures 4C and 4D is located upstream of the nozzle since **the wire dispenser feeds the wire into the nozzle**") (emphasis in original); *see* Pet. at 30.

21. The wire dispensers of FIGS. 4C and 4D include wire cutters 21. Ex.1002, ¶111; Pet. at 29-30. A POSITA would have understood that because the entire wire dispenser is upstream of the nozzle 22, a wire cutter 21 included in the wire dispenser embodiments of FIGS 4C and 4D is also upstream of the nozzle 22. A POSITA would have also understood that because the wire cutter 21 is upstream to the nozzle 22, the wire ("*the continuous strand*"), *see* Ex.1002, ¶¶95-103; Pet. at 25-27, would be cut before the wire is combined or coated with the adhesive (the "*primary material*") to form a path of "*composite material*," *see id*., emitted from the nozzle. The only material that would be emitted after the wire is cut is a portion of the path that contains only the adhesive ("*primary material*"). Accordingly, as explained in the Petition-Declaration, Lipsker teaches selectively cutting the wire before the wire may be emitted from the nozzle 22, and thus teaches claim element 20[d]. Ex.1002, ¶¶110-111; Pet. at 29-31.

V. GROUNDS 2 AND 6: LIPSKER AND MA OR MA AND LIPSKER COMBINATIONS RENDER CLAIMS 1-4, 9-12, 20, AND 21 OBVIOUS

A. Regarding Claims 1 and 9, the Petition-Declaration Relies only on Lipsker's Precoating (FIG. 5) Embodiment, and Did Not Propose

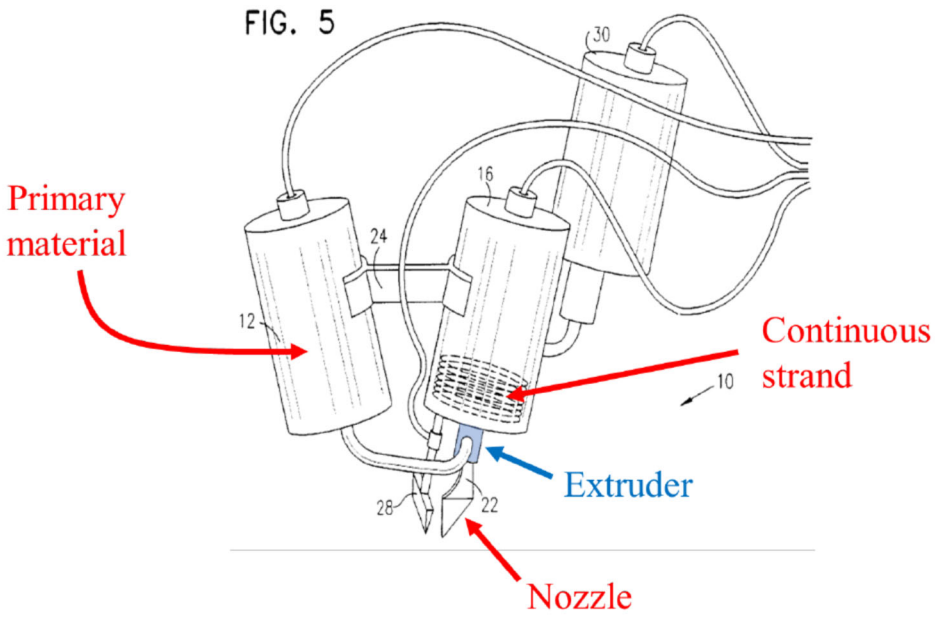
a Combination of Lipsker's Non-precoating (FIG. 2) and Precoating (FIG. 5) Embodiments

22. In the Petition-Declaration, the Lipsker-Ma combination is discussed under Ground 2. Under this Ground, all of the limitations of claims 1 and 9 are disclosed referring to Lipsker's precoating embodiment of FIG. 5. Ex.1002, ¶¶121-142, 159-167; Pet. at 36-43 and 50-53. PO alleges that Petitioner relies on Lipsker's precoating embodiment (FIG. 5) for claim elements 1[a]-1[b] and 9[a]-9[c], but relies on the non-precoating embodiment (FIG. 2) for claim elements 1[c] and 9[d]. POR at 37. This allegation fails, as I explain below.

23. A substantive difference between Lipsker's non-precoating (FIG. 2) and precoating (FIG. 5) embodiments is that in the former embodiment (FIG. 2), the adhesive is dispensed directly from an adhesive dispenser 12 and the wire is dispensed separately, from a wire dispenser 16. Ex.1006, 3:27-28 (describing an apparatus 10 having an adhesive dispenser 12), 47-48 (describing a **wire dispenser 16** of the apparatus 10), 5:22-31, FIGS. 1 and 2. In contrast, in the latter precoating embodiment (FIG. 5), the adhesive and wire are dispensed together. *Id*., 5:53-59, FIG. 5; Ex.1002, ¶¶121-133, 159; Pet. at 36-39, 49-50. Specifically, the "[a]dhesive dispenser 12 may be located so as to dispense adhesive 14 into nozzle 22 such that the wire 18 [] dispensed from wire dispenser 16 [is] pre-coated with adhesive 14." Ex.1006., 5:53-59.

24. I note that in the apparatus depicted in FIG. 1, and in both the non-precoating (FIG. 2) and precoating (FIG. 5) embodiments, the adhesive dispenser is identified by the reference numeral 12, the adhesive is identified by reference numeral 14, the wire dispenser is identified by reference numeral 16, the wire is identified by reference numeral 18, and the nozzle is identified by reference numeral 22. *Id*., 3:27-28, 47-50, 5:22-31, FIGS. 1, 2, and 5.

25. Referring to the precoating embodiment of FIG. 5, the Petition-Declaration identifies an outlet of Lipsker's wire dispenser 16 as the "extruder" recited in claim elements 1[a] and 9[a]. Ex.1002, ¶¶126-129; Pet. at 25-27, 37-38.



Ex.1002, ¶¶95-97 (reproducing Ex.1006, FIG. 5 (annotated)); Pet. at 26.

26. Claim elements 1[c] and 9[c] recite "moving the extruder." Ex.1001,

10:65-67, 11:36-39. Lipsker discloses the movement of the wire dispenser 16, including its outlet, i.e., the movement of "extruder" in discussing FIG. 1. Ex.1006, 4:60-63 (stating that "[a]pparatus 10 includes an actuator 30 which moves adhesive dispenser 12 and wire dispenser 16"), 5:17-19, FIG. 1; Ex.1002, ¶¶131-136; Pet. at 40. Lipsker does not repeat this discussion for FIGS. 2 and 5. Ex.1006, 5:22-41 and 5:55-6:9. This is the reason why the Petition-Declaration cites Lipsker's discussion of FIG. 1 for claim elements 1[c] and 9[c]. The discussion of FIG. 1 applies equally to FIGS. 2 and 5, as explained below.

27. In light of the fact that FIGS. 1, 2, and 5 refer to various components using the same reference numerals, a POSITA would have readily understood and appreciated that the disclosure of the movement of the wire dispenser 16 depicted in FIG. 1 applies to the wire dispenser 16 depicted in FIGS. 2 and 5, as well. A POSITA would have also known that for moving the wire dispenser 16 (and its outlet, the "extruder") depicted in FIG. 5, a combination or modification of the embodiments of FIGS. 1 and 5 and/or FIGS. 2 and 5 is not needed. The Petition-Declaration does not suggest or rely upon such a combination or modification. *See* Ex.1002, ¶¶ 121-142, 159-167; Pet. at 36-43 and 50-53.

28. Claim element 9[d] recites "hardening the path." Ex.1001, 11:40-41. PO alleges that Petitioner relies on Lipsker's FIG. 2 for this claim element. POR at

37. As discussed above in Section IV(A), hardening the path is achieved by curing the adhesive, and such curing and hardening occurs regardless of whether the adhesive is dispensed separately from a wire per the non-precoating embodiment of FIG. 2 or together with the wire, forming the composite material, per the precoating embodiment of FIG. 5. *See supra*, § IV(A). Therefore, as I also explained in Section IV(A), a combination of Lipsker's two embodiments is neither necessary nor proposed in the Petition-Declaration. *See supra*, § IV(A).

29. Accordingly, a single embodiment of Lipsker, in combination with Ma, discloses all of the elements of claims 1 and 9, as explained in the Petition-Declaration. *See* Ex.1002, ¶¶ 121-142, 159-167; Pet. at 36-43 and 50-53.

B. Lipsker-Ma and Ma-Lipsker Combinations Both Teach All Elements of Claims 20 and 21

30. In the Lipsker-Ma and Ma-Lipsker combinations under Grounds 2 and 6, respectively, for claims 20 and 21, the Petition-Declaration relies on a single embodiment of Lipsker. *See* Ex.1002, ¶ 175-190 (referring to the disclosure of Lipsker provided for claims 20 and 21 in Ground 1 and for claim 1 in Ground 2); Pet. at 55-60. PO repeats the allegation it made for Ground 1, that Petitioner relies on two different embodiments of Lipsker, and does not provide motivation to combine those embodiments. POR at 37. This argument fails for the reasons provided for Ground 1. *See supra* § IV(A).

C. In the Lipsker-Ma and Ma-Lipsker Combinations, It Is Not Necessary to Select Ma's Passive Pulling, and a POSITA Would Have Been Motivated to Combine These References as the Petition-Declaration Explained

31. Lipsker-Ma and Ma-Lipsker combinations under Grounds 2 and 6, respectively, teach all of the limitations of claims 1-4, 9-12, 20, and 21, and the Petition-Declaration provided adequate motivation for these combinations. Ex.1002, ¶¶121-196, 273-282; Pet. at 34-60, 83-86. PO and the Board both state that Ma discloses the passive pulling only once while discussing the active pushing method at least eight times, and also disparages the pulling embodiment of Ma. POR at 38-40; Institution Decision at 17-18 and 24-26. PO and the Board state further that Petitioner did not provide adequate motivation to combine Lipsker and Ma. POR at 40-46; Institution Decision at 16-19. Based on this, the Board contends that the Lipsker-Ma combination may not render independent claims 1 and 9 obvious. Institution Decision at 24-26.

32. As explained below, the proposed combinations do render claims 1-4, 9-12, 20, and 21 obvious and the Petition-Declaration did provide sufficient motivation to combine Lipsker and Ma. Ex.1002, ¶¶192-196; Pet. at 34-36. In particular for independent claims 1, 9, 20, and 21, the Petition-Declaration explained that Lipsker independently discloses all of the actions recited in those

claims. Ex.1002, ¶¶121-136, 159-167, 175-185; Pet. at 36-41, 49-53, 55-57.[3] I discuss below that a combination of Ma with Lipsker is provided only to demonstrate the claimed effects of one of such actions. The Petition-Declaration neither proffered nor relied on any combination or replacement of the components of Lipsker's and Ma's systems, or the steps of their respective operations, and did not propose or rely on any modifications of these systems or their respective operations. *See* Ex.1002, ¶¶192-196, 121-142, 159-167, 175-190; Pet. at 34-43, 49-53, 55-60.

33. As a threshold matter, claims 1 and 9 do not recite pulling a path or generating a tension in a path as actively performed steps. Rather, the step that is actively performed is "**moving the extruder** during emitting **such that**" "the path is pulled" (per claim 1), and "**moving the extruder** during emitting **to generate tension** in the path" (per claim 9). Ex.1001, 10:59-67, 11:30-41. The transition phrases "such that" and "to generate" inform that the subsequent action is the result or effect of the preceding action. Specifically, the pulling or extending of the path

[3] Additionally, Ma also independently discloses all of the elements of independent claims 1, 9, 20, and 21. Ex.1002, ¶¶121-138, 159-167, 175-190; Pet. at 36-42, 49-53, 55-60.

and generating tension in the path are the **effects** of the actively performed step of "moving the extruder."

34. The Petition-Declaration explains that Lipsker, by itself, discloses "moving the extruder." Ex.1002, ¶¶134-136; Pet. at 39-41, 50-51. The composite material forming a path that Lipsker discloses includes an adhesive. Ex.1002, ¶¶95-100, 126-129; Pet. at 25-27 and 37-38; Ex.1006, 5:53-60. An adhesive in general, and the one that Lipsker discloses is viscous; that is, has a high enough viscosity. Ex.1006, 6:4-9 (stating that design parameters including viscosity of the adhesive must be chosen carefully). Ma's towpreg, i.e., the extruded composite material, also has a sufficiently high viscosity. Ex.1007 at 41 (stating that a matrix material forms the towpreg), 46 (stating that a material having "very low viscosity" "may not be able to maintain its own shape" and "may flow around arbitrarily," and further that a "basic requirement for matrix materials" is that "the material fluid should maintain a geometric shape when the matrix is carried to a forming platform").

35. A POSITA would have known that a viscous material, such as Lipsker's adhesive, or Ma's towpreg, can deform under stress, i.e., when a force is applied, e.g., by the movement of Lipsker's extruder. A POSITA would also know that the deformity, also called a strain, can be in the form of stretching or pulling of

the adhesive.

36. In particular, a high-school physics textbook (Ex.1024) explains that "[s]tress (σ) and strain (ϵ) is [sic] one of the most fundamental concepts used in the mechanics of materials." Ex.1024, ch. 12 at 194. In the context of a solid object, the textbook states that stress is the force applied to an object over the cross-sectional area of the object. *Id*. Under the stress, the solid object can deform, i.e., it can compress or it can elongate under a tensile stress. *See id*., Figures 12.1, 12.2. The "strain" in the object "is defined as the fractional change in length of the" object. *Id*.

37. The concepts of stress and strain are not limited to solids, and apply to fluid as well. Specifically, Crowe *et al*. explain that "[v]iscosity (also called dynamic viscosity, or absolute viscosity) is a measure of a fluid's resistance to deformation under shear stress." Ex.1025 at 18. "Shear stress, τ, tau, is the ratio of force/area on a surface when the force is aligned parallel to the area. Shear strain is a change in an interior angle of a cubical element, $\Delta\phi$, that was originally a right angle." *Id*. at 18-19, Figure 2.1 (illustrating $\Delta\phi$). In fluid flow, "the shear stress on a fluid element is proportional to the rate (speed) of strain, and the constant of proportionality is the viscosity." *Id*. at 18.

38. Thus, the effect of the movement of the extruder, when the composite

material path is anchored, is that the path of the composite material is deformed. In particular, the path is stretched, i.e., the "path is pulled" (per claim 1). The stretching would result in "generat[ing] tension in the path of the composite material" (per claim 9). Furthermore, the composite path that Lipsker discloses includes an adhesive, which is under shear stress at the anchor. The tension in the path and the shear at the anchor can be seen clearly in Figure 9 from the '708 patent (Ex.1001).

39. A POSITA would have understood that the movement of the extruder in Ma's passive pulling technique causes shear stresses and tension forces similar to that in a system of the '708 patent. This can be seen in Ma's Figure 2-19 (annotated). Due to the pulling action of the extruder movement, the adhesive at the anchor is under shear. Until the adhesive fully cures, the high viscosity of the adhesive enables the adhesive to support the shear stress and enables the composite path to be under tension. The teachings of Ma that are discussed in the Petition-Declaration would have informed a POSITA of these effects.

40. In particular, with reference to its FIG. 9, the '708 patent states:

> FIG. 9 shows a tension path 901. The composite path is first extruded onto an anchor 903. Any surface or point may provide an anchor point. In FIG. 9, the anchor is a vertical plane. The origin of the path

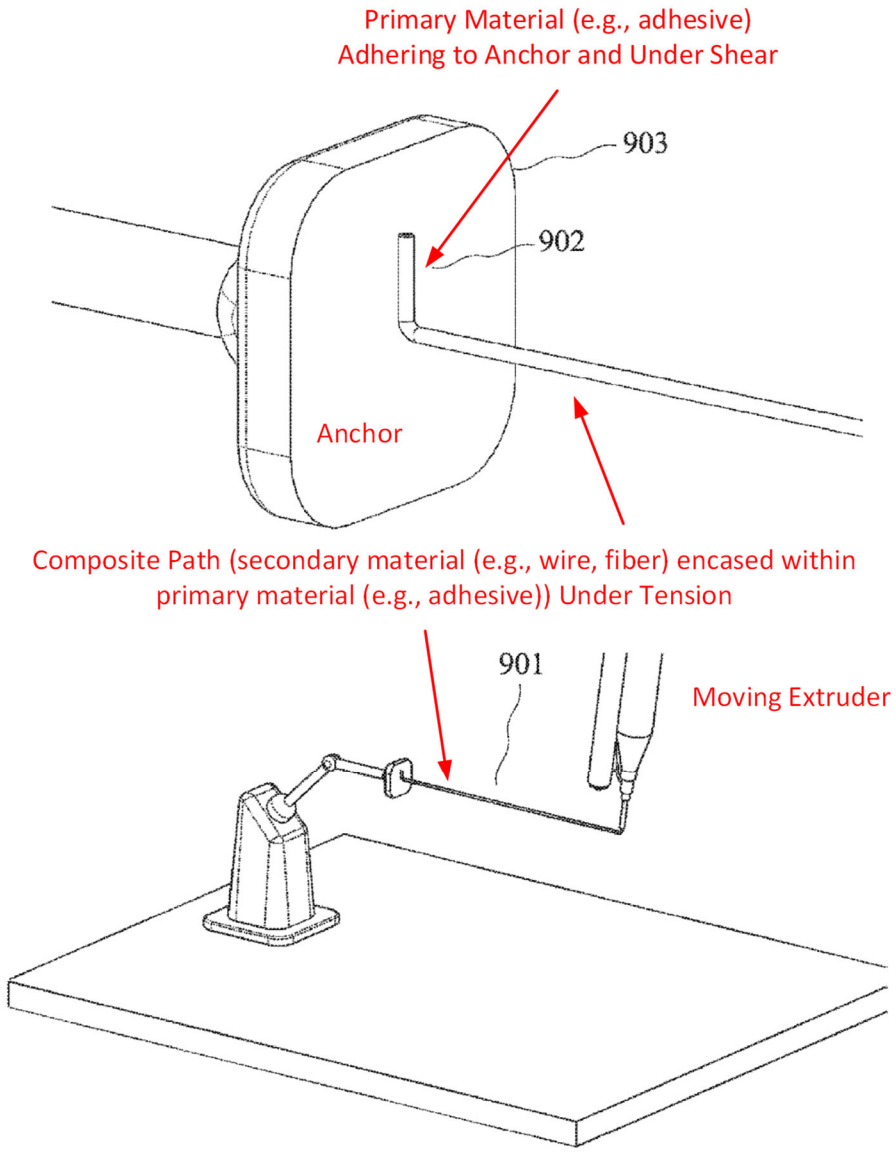
> adheres to the anchor, allowing the extruder to pull on the secondary material during the extrusion.

Ex.1001, 10:4-9, FIG. 9. The '708 patent further states:

> The initial contact between the proposed part and the anchor must provide enough adhesion to support the tension force desired. Paths of greater tension may require an additional length of path extruded upon the anchor, to provide more adhesion. FIG. 9 shows a short length of path 902 extruded upon the anchor prior to extending horizontally away.

Id., 10:14-20, FIG. 9.

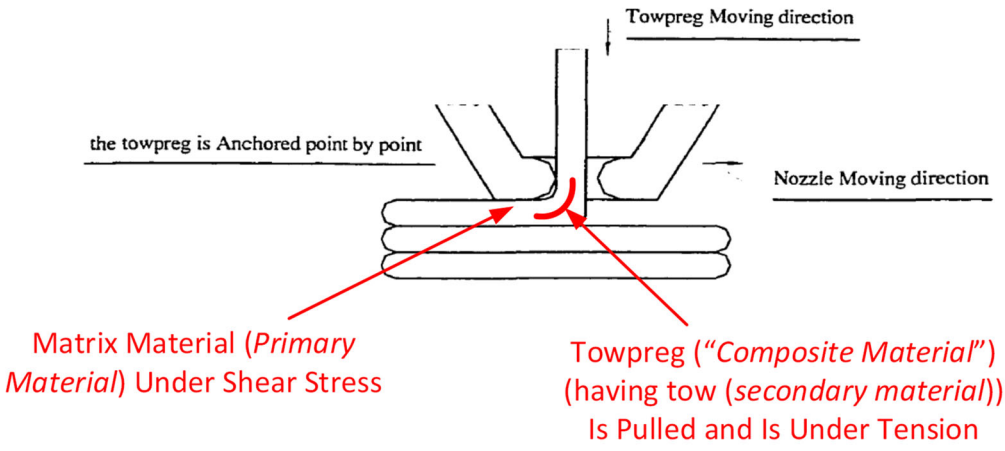
41. Thus, when the primary material (e.g., an adhesive) adheres to the anchor, if the extruder is moved, the composite path having the secondary material (e.g., a wire or a fiber) coated with the primary material (e.g., the adhesive) is pulled, and tension is generated in the path.



Ex.1001, FIG. 9 (annotated).

42. Likewise, in Ma's passive pulling embodiment, a towpreg may include "a fiber tow with a matrix material in a liquid state (e.g., melt)." Ex.1007 at 29. When the towpreg is directed via a nozzle to an anchor, the matrix material adheres to the anchor. Ex.1007 at 68-72 (disclosing that "[d]uring the deposition

step, the nozzle is pressed on the molten towpreg to help it adhere to the previous layer" and that upon solidifying, "glued to the previous layer immediately," forming "a series of anchor points"), Figure 2-19. When the nozzle (an extruder) is moved, the towpreg is pulled and may be stretched. *Id*. at 72 ("Because the anchor points adhered to the object, the towpreg should be pulled automatically out from the nozzle when the nozzle is continuously moved relative to the object."). During this process, the matrix material is under shear stress, and the towpreg that is pulled is under tension.



Id., Figure 2-19 (annotated).

43. Specifically, regarding claim element 1[c], the Petition-Declaration states that per Ma's passive method "'when the object is moved relative to the nozzle during the forming process, the **towpreg is pulled out** by the object.'" Ex.1002, ¶¶137-138 (citing Ex.1007, p. 38) (original emphasis removed and

emphasis added); Pet. at 42. The Petition-Declaration further states that a "POSITA would have understood that the anchor points, as disclosed by Lipsker and Ma, can therefore [be] used to pull the path out from the extruder." *Id*. at 141.

44. Regarding claim elements 9[c], Ma discloses that "[b]ecause the towpreg that links the nozzle and the object has a high **tensile strength**, it is possible to use Passive Material Supplying." Ex.1002, ¶138 (quoting Ex.1007 at 38) (emphasis removed in part). Accordingly, the Petition-Declaration states that "Ma discloses that tension develops in the form of tensile forces inside the towpreg **as a result of the nozzle's movement relative to the anchored points** when the towpreg is passively supplied through the extruder." *Id*., ¶163 (emphasis original); Pet. at 52. Lipsker and Ma are combined to inform a POSITA of these pulling and tension generating **effects** of the movement of Lipsker's extruder. Ex.1002, ¶¶134-142, 160-164; Pet. at 39-43, 50-52.

45. Ma identifies the passive pulling as a known technique. *See* Ex.1007 at 68 and 72, Fig. 2-19; Ex.1002, ¶77 (citing Ex.1007, pp. 68, 72 and Fig. 2-19); *see also*, Ex.1007 36-38, and 66. In particular, Ma discloses that the towpreg (a composite material) "should be **pulled automatically** out from the nozzle when the nozzle is continuously moved." Ex.1007 at 72, Fig. 2-19; Ex.1002, ¶¶77, 137-139 (citing Ex.1007, p. 72 and Fig. 2-19).

46. Additionally, Ma does not unilaterally discuss the benefits of the active method. Rather, Ma compares "advantages and shortcomings" of both methods. Ex.1007 at 66 ("The advantages and shortcomings of the Active and Passive Material Supplying are compared and summarized."). Specifically, Ma identifies the simplicity of the system as a benefit of passive pulling. *See* Ex.1007 at 68; Ex.1002, ¶77 (citing Ex.1007, p. 68); Ex.1007 at 66-68 (stating that the "machinery and controlling system for [the active] method are relatively complex" and that the "machinery and controlling system for [the passive] method are relatively simple"). Furthermore, Ma provides improvement to both active and passive techniques. Ex.1007 at 68 ("Two concept designs are described for the Active Material Supplying and Passive Material Supplying methods, respectively. The dissertation research was centered on these **two methods**.").

47. Thus, Ma does not disparage the passive pulling method, and instead, discloses a "concept design" based thereon. In light of Ma's teachings regarding the passive method that are discussed above, the Board's contention that Ma "seemingly disparages the passive 'pulling' method," *see* Institution Decision at 18, is erroneous. A POSITA would not have ignored Ma's passive pulling embodiment, and would have considered it for its advantages, including the simplicity of the system.

48. In the Lipsker-Ma and Ma-Lipsker combinations, no component or operation from Ma needs to be added to Lipsker's system and its operation. No component or operation that Lipsker discloses needs to be replaced with Ma's component or operation. *Id*. For example, either of the wire dispenser designs shown in Figures 4A and 4B in Lipsker could be used as the wire dispenser 16; the specific nozzle design in Figure 2-19 of Ma need not be used. In fact, no modification of Lipsker's system and its operation is needed and the Petition-Declaration neither proposed nor relied on any such modification. Further, considering the Ma-Lipsker combination, there is no reason to replace Ma's nozzle in Figure 2-19 with any of Lipsker's nozzle / wire dispenser designs, nor is there a reason to replace any other component in any of Ma's system designs with a component from Lipsker. *See* Ex.1002, ¶¶ 192-196, 121-142, 159-167, 175-190; Pet. at 34-43, 49-53, 55-60.

49. Rather, these combinations are proposed because the combination of the teachings of Lipsker and Ma would inform a POSITA, that when Lipsker's wire dispenser 16 (the "*extruder*") is moved, the wire precoated with an adhesive (the "*composite material*") would be pulled, stretched, or extended, and tension would be generated therein automatically, as the **effects** of the movement of the extruder that Lipsker teaches. Ma illustrates the path extrusion and pulling effect

in details. A POSITA would have understood that the **effects** of pulling, extending, or generating tension in the path of a composite material extruded from Lipsker's system would be achieved automatically due to the movement of the wire dispenser 16 (the "extruder") that Lipsker teaches.

50. The motivation to combine that the Petition-Declaration provides explains the above-described **effects** of the movement of Lipsker's extruder. Ex.1002, ¶¶192-196; Pet at 34-36. No components or operations from Ma are added to Lipsker's system and its operation, or are used to replace any components or operations of Lipsker's system. No modification of Lipsker's system and its operation are needed, and the Petition-Declaration neither proposed nor relied on any such modification. Likewise, no modification of Ma's system is required and the Petition-Declaration did not propose or rely on such a modification. Ex.1002, ¶¶192-196, 121-142, 159-167, 175-190; Pet. at 34-43, 49-53, 55-60. Therefore, the Petition-Declaration provides sufficient motivation to combine Lipsker and Ma. *See* Ex.1002, ¶¶ 192-196; Pet. at 34-36.

D. The Petition-Declaration Explains that Lipsker and Ma Teach Claim Element 9[d]

51. Claim element 9[d] recites "hardening the path of composite material to retain the tension in the path of composite material." Per the Lipsker-Ma combination in Ground 2, Lipsker and Ma both teach this limitation. Ex.1002, ¶¶

165-166 (citing Ex.1007, p. 41); Pet. at 52-53; *see* Ex.1002, ¶¶148-154 (discussing claim 3, which recites "aiming light" "to cause the primary material to harden"), ¶¶104-109 (discussing claim 20, which also recites "hardening the path"); Pet. at 45-48 and 28-29. PO alleges that the Lipsker-Ma combination does not teach "hardening . . . to retain the tension in the path." POR at 46-49. This is an error, as I explain below.

52. As a threshold matter, the terms "retain" and "tension" can be found only in claim 9 of the '708 patent, and are not discussed anywhere in the specification. *See* Ex.1001, 11:30-41; *see generally*, *id*. Additionally, as discussed above in Section V(C) in the Petition-Declaration, I explained that Lipsker teaches "moving the extruder" and that the effect of such movement is generating tension in the extruded path. *See supra*, § V(C). A POSITA would have understood, however, that upon generating tension in a path by moving the extruder, if the path were hardened soon after the extrusion, the tension generated therein would be retained.[4]

[4] If a POSITA lacked such knowledge, claim 9 would not be supported by written description and would not be enabled. Claim 9 would therefore be invalid at least for those reasons.

53. The Petition-Declaration explained that Lipsker teaches moving the extruder and, to the extent a POSITA did not know already, Ma informs that such a movement generates tension in the extruded path. *See supra*, § V(C). The Petition-Declaration further explained that Lipsker and Ma both teach curing, i.e., hardening the extruded path, and that Ma teaches curing the path "as soon as possible." Ex.1002, ¶165-166; Pet. at 52-53; *see id*. at 45-48.

54. Specifically, Ma describes that "a matrix material in a liquid state" may be used to "impregnate[] a fiber tow" so that "the impregnated tow (towpreg)" may be laid "point-by-point and layer-by-layer" to form an object. Ex.1007 at 29. Regarding the selection of a suitable matrix material forming a towpreg, i.e., the extruded composite material, Ma states that the "phase change speed" of the matrix "must be sufficiently high" so that the matrix material upon receiving energy, e.g., via curing, can "change it physical state **as soon as possible**." *Id*. at 41; Ex.1002, ¶166 (citing Ex.1007 at 41) (emphasis original).

55. Therefore, a POSITA would have known that the tension in the extruded path generated by the movement of the extruder would be retained soon after the extrusion path is hardened by curing, as both Lipsker and Ma teach. Ex.1002, ¶¶165-166; Pet. at 52-53; *see* Ex.1002, ¶¶104-109, 148-154; Pet. at 28-29, 45-48. Thus, Lipsker and Ma, individually and in combination, teach claim

element 9[d], as described in the Petition-Declaration. Ex.1002, ¶¶165-166; Pet. at 52-53; *see* Ex.1002, ¶¶104-109, 148-154; Pet. at 28-29, 45-48.

E. Lipsker and Ma Combinations Do Teach "Selectively Cutting" Recited in Claim 20

56. Claim element 20[d] recites the "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." The Petition-Declaration explained under Grounds 2 and 6 that the Lipsker-Ma and Ma-Lipsker combinations teach this limitation because Lipsker discloses selectively cutting a wire ("*the continuous strand*") before the wire coated with an adhesive ("*the path of composite material*") is emitted such that at least a portion of the path emitting from the extruder contains only the adhesive ("*primary material*"). Ex.1002, ¶¶110-112, 179, 281; Pet. at 29-31, 56, 86. PO repeats the allegation it made for Ground 1, that Lipsker does not teach selective cutting. POR at 49-50. This argument fails for the reasons I have provided for Ground 1. *See supra* § IV(B).

VI. GROUNDS 3, 7, AND 8: LIPSKER-CRUMP, MA-CRUMP, AND MA-CRUMP-LIPSKER COMBINATIONS RENDER CLAIMS 5-8 OBVIOUS

57. The Lipsker-Crump combination teaches all of the limitations of claims 5-8. Ex.1002, ¶¶ 197-219; Pet. at 62-68. Ma-Crump and Ma-Crump-

Lipsker combinations also teach all of the limitations of claims 5-8. Ex.1002, ¶¶283-396, 302-305; Pet. at 88-91 and 93-94. PO and the Board contend that: (i) Lipsker and Crump do not teach an anchor point; (ii) Petitioner does not provide an adequate motivation to combine Lipsker and Crump and Ma and Crump; and (iii) Ma allegedly disparages the passive pulling technique. POR at 50-56, 62-65; Institution Decision at 20-22, 26-27.

58. As explained below, the combinations discussed in my Petition-Declaration do teach all of the elements of claims 5-8, where sufficient motivations to combine Lipsker and Crump; Ma and Crump; and Ma, Crump, and Lipsker (collectively, "Lipsker-Crump-Ma Combinations") are provided. Ex.1002, ¶¶221-224, 298-301, 306-310; Pet. at 60-61, 86-88, 92-93. In particular, the Petition-Declaration explained that Lipsker, Ma, and Crump each discloses anchor points. *See* Ex.1002, ¶¶136-140, 208; Pet. at 41-42, 65. The Petition-Declaration also explained that **Lipsker and Ma both disclose all of the actions** that claim 5 recites. *See* Ex.1002, ¶¶197-213, 283-295; Pet. at 62-67, 89-91. As I explain below, **Crump would have informed a POSITA the effect of these actions**, which is the result recited in claim 5.

A. Each of Lipsker, Ma, and Crump Teaches an Anchor

59. Contrary to PO's allegation, *see* POR at 54-56, Lipsker, Ma, and

Crump each discloses an anchor. Ex.1002, ¶136-140, 208; Pet. at 41-42, 65. PO construes an "anchor" as a "contact to which the path of composite material is adhered to enable pulling of the path." POR at 15. The Court and the Board additionally require that an anchor "serve[] as an origin point" for a path of the composite material. Ex.1023 at 2; Ex.1018 at 12. As I explain below, Lipsker, Ma, and Crump each discloses an "anchor" per PO's construction, and also per the Board's and Court's constructions.

60. Lipsker discloses that "'[a]dhesive 1[4] may be applied to bond wire 18 to bed 26 . . . to fix the first layer of wire 18 in place." Ex.1002, ¶136; (quoting Ex.1006, 5:50-52); Pet at 41. The location on the bed 26 where the adhesive is deposited is a contact point to which the composite of the wire 18 and the adhesive 14 ("*the path of composite material*") is adhered. Due to the adhesive, the path would be pulled, when the extruder is moved. *See supra*, § V(C). Moreover, the contact point on the bed 26 also serves as a point of origin for the path pulled from that point. Thus, Lipsker discloses an "*anchor*" per PO's, and the Board's and Court's constructions.

61. In describing the passive pulling method, Ma states that "the towpreg forms a series of anchor points" and that "[b]ecause the anchor points are adhered to the object, the towpreg should be pulled automatically out from the nozzle when

the nozzle is continuously moved relative to the object." Ex.1007 at 72, Fig. 2-19; Ex.1002, ¶¶77, 137-141 (citing Ex.1007, p. 72 and Fig. 2-19); Pet. at 19, 41-42, 57-59. Each of Ma's anchor points is a contact point to which a towpreg path ("*composite path*") is adhered, and a contact point from which that path originates and is pulled. Therefore, Ma also teaches an "*anchor*" per PO's, and the Board's and Court's constructions.

62. Crump discloses locations 180a and 180b on a substrate 108 to which "multiple, free-standing strands 180 defining wire frame segments [are] anchored." Ex.1008, 15:23-27, FIG. 12; Ex.1002, ¶208 (citing Ex.1008, 15:21-51, FIG. 12); Pet. at 65.

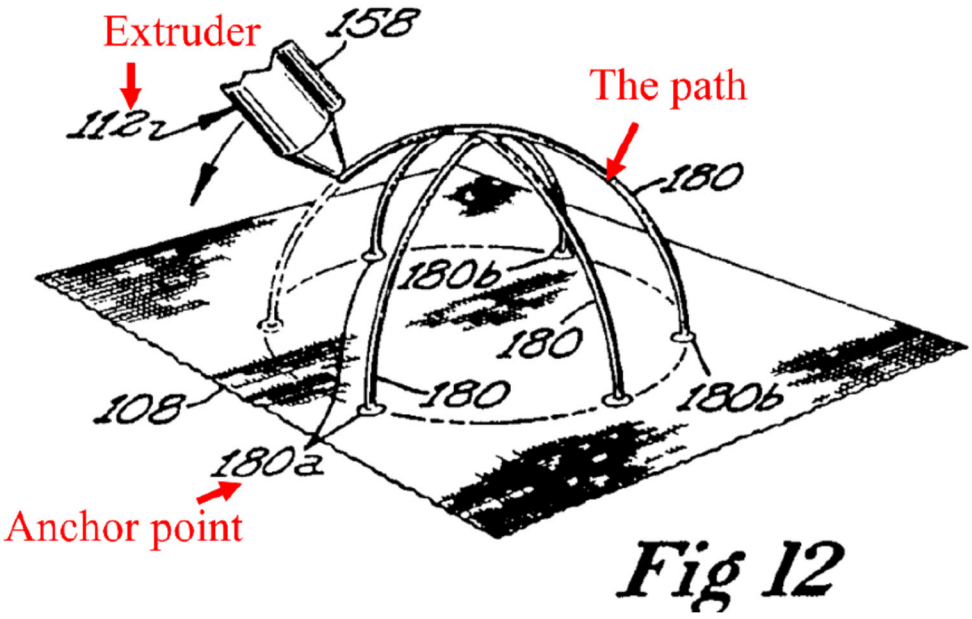


Fig 12

Pet. at 65 (providing Ex.1008, FIG. 12 (annotated)).

63. Each of the substrate locations 180a, 180b is an anchor point because

each location is a contact point to which a respective strand 180 is adhered. From each of the contact points 180a, 180b, a respective wire strand path originates and is pulled. Therefore, Crump also teaches an "*anchor*" per PO's, and the Board's and Court's constructions.

B. A POSITA Would Have Been Motivated to Combine Lipsker and Crump; Ma and Crump; and Ma, Crump, and Lipsker as the Petition-Declaration Explained

64. Claim 5 recites "**moving the extruder** during emitting **such that**" "the path of composite material **extends from an anchor through free space**" and "**hardening** the path **at a fixed location** in three-dimensional space **without support** between the anchor and the extruder." Ex.1001, 11:9-21. Under Grounds 3 and 7 in my Petition-Declaration, I explain that Lipsker and Ma both disclose "moving the extruder" and "hardening" an extruded composite path. Ex.1002, ¶¶206-207, 293-295; Pet. at 64-67, 90-91.

65. As discussed above in Section V(C), Ma does not disparage the passive pulling method. Rather, Ma discloses simplicity of the passive pulling system as a benefit of that technique, and also discloses a concept design based on the pulling method. *See supra*, § V(C). Therefore, a POSITA would have been motivated to use Ma's passive pulling technique.

66. As also discussed in Section V(C), the **effect** of the movement of the

extruder, when the composite-material path is anchored, is that tension is created in the composite-material path. *See supra*, § V(C). A further effect of the tension is that the path stretches under the tension, *see id*. (discussing the stretching of Lipsker's wire coated with an adhesive or Ma's towpreg), i.e., the "path of composite material **extends from an anchor through free space**." The **effect** of hardening the extruded path is that it would not move, and remain "**at a fixed location** in three-dimensional space **without support** between the anchor and the extruder."

67. Crump discloses the above stated effect. Specifically, Crump discloses locations 180a and 180b on a substrate 108 to which "multiple, free-standing strands 180 defining wire frame segments [are] anchored." Ex.1008, 15:23-27, FIG. 12; Pet. at 65 (citing Ex.1008, 15:21-51, FIG. 12). Crump also discloses that the nozzle dispensing a strand can be moved in X, Y, and Z axes, and that the strand solidifies in space, thereby forming an anchored path in a three-dimensional space, where the path remains in its position without support. Ex.1008, 15:23-27, FIG. 12; Ex.1002, ¶208 (citing Ex.1008, 15:21-51, FIG. 12); Pet. at 65.

68. To the extent a POSITA did not already know that the effects of moving an extruder and curing/hardening the extruded material are to form three-

dimensional paths that are anchored to a selected location and can stand without support, the teachings of Crump that are discussed in the Petition-Declaration would have informed a POSITA of these effects. This is the reason why the Petition-Declaration discusses Lipsker and Crump; Ma and Crump; and Ma, Crump, and Lipsker combinations. Ex.1002, ¶¶206-207, 293-295; Pet. at 64-67, 90-91.

69. The motivations to combine that are provided in the Petition-Declaration explain the above-described **effects**, that the composite material emitted from Lipsker's system would be pulled due to the movement of Lipsker's extruder, and that the composite material would harden upon curing to form free-standing, three-dimensional structures. Ex.1002, ¶¶221-224, 298-301, 306-310; Pet. at 60-61, 86-88, 92-93. Similar arguments were made concerning Ma's systems. Ex.1002, ¶¶289-292, 293-295, 297-301. The Petition-Declaration neither proposes nor relies 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. Ex.1002, ¶¶221-224, 298-301, 306-310; Pet. at 60-61, 86-88, 92-93. Accordingly, the Petition-Declaration provided sufficient motivation for Lipsker-Crump-Ma combinations, and has shown that claims 5-8 are obvious over Lipsker-Crump-Ma combinations. Ex.1002, ¶¶197-219, 283-396,

302-305; Pet. at 62-68, 88-91 and 93-94.

VII. GROUND 4, 9 AND 10: LIPSKER-NIKZAD, MA-NIKZAD, AND MA, NIKZAD, LIPSKER COMBINATIONS RENDER CLAIMS 13-19 OBVIOUS

70. The Lipsker-Nikzad combination in Ground 4, and Ma-Nikzad and Ma-Nikzad-Lipsker combinations in Grounds 9 and 10, render claims 13-19 obvious. Ex.1002, ¶¶225-262, 311-322, 328-339; Pet. at 70-81, 95-103. PO alleges that the Lipsker-Nikzad combination does not render independent claim 13 and 17 obvious because a POSITA would not have combined Lipsker's non-precoating and pre-coating embodiments. POR at 56-57. PO did not address Grounds 9 and 10, *see generally*, but the Board contends that Ma-Nikzad and Ma-Nikzad-Lipsker combinations do not render these claims obvious because Ma allegedly disparages the passive pulling method, and because a POSITA would not be motivated to combine Ma and Lipsker. Institution Decision at 27-28.

71. PO's allegation regarding combining two of Lipsker's embodiments fails. As discussed above in Section V(A), Lipsker's non-precoating and pre-coating embodiments need not be combined and the Petition-Declaration neither proposed nor relied on such a combination. *See supra*, V(A). Therefore, as explained in the Petition, the Lipsker-Nikzad combination renders claims 13-19 obvious. Ex.1002, ¶¶225-267; Pet. at 68-81.

72. As discussed above in Section V(C), Ma does not disparage the passive pulling method. Rather, Ma discloses simplicity of the passive pulling system as a benefit of that technique, and also discloses a concept design based on the passive pulling technique. Therefore, a POSITA would have been motivated to use Ma's passive pulling technique. *See supra*, § V(C). Moreover, as also discussed in Section V(C), the components or operations of Ma's and Lipsker's system need not be combined or replaced, and the Petition-Declaration neither proposed nor relied on any such modifications. *See supra*, § V(C). Therefore, as explained in the Petition, Ma-Nikzad and Ma-Nikzad-Lipsker combinations render claims 13-19 obvious. Ex.1002, ¶¶311-342; Pet. at 94-103.

VIII. GROUND 5: MA RENDERS CLAIMS 1, 2, 9, 10, AND 21 OBVIOUS

73. Ma teaches all of the elements of the claims challenged under Ground 5. Ex.1002, ¶¶268-272; Pet. at 82-83. PO alleges that Ma does not render claims 1, 2, 9, 10, and 21 obvious because a POSITA would not have selected and combined Ma's different embodiments, including the allegedly disparaged passive pulling method. POR at 57-61. The Board also alleges that a POSITA would not have used Ma's passive pulling method over the active pushing method. Institution Decision at 24-25.

74. It is explained above that Ma does not disparage the passive method.

Instead, Ma recognizes the pulling method as a known technique, discloses simplicity of the system as a benefit thereof, and further discloses a "concept design" based on the pulling method. *See, supra*, § V(C); Ex.1007 at 66-68, Fig. 2-19. The Petition-Declaration relies on the passive, pulling embodiment that Ma discloses to show all of the limitations of the claims challenged under Ground 5. Ex.1002, ¶¶268-272; Pet. at 82-83.

75. Therefore, Ma discloses an embodiment that discloses all of the limitations of claims 1, 2, 9, 10, and 21, and at least one benefit of the pulling method. Therefore, a POSITA would have chosen the pulling method because it is already known, and because its implementation was known to be simpler than that of the active pushing method. Accordingly, Ma renders claims 1, 2, 9, 10, and 21 obvious, as explained in the Petition. Ex.1002, ¶¶268-272; Pet. 82-83.

IX. CONCLUSION

76. Based on my review of the '708 patent, the materials referenced herein, and my knowledge of what a POSITA would have known at and before the '708 patent's priority date about the technology at issue, a POSITA would have understood all of the claim elements and limitations of Challenged Claims to be present and described in the references cited under Grounds 1-10. Furthermore, a POSITA would have been motivated to combine these references, for the reasons I

have discussed. I believe that PO's arguments in the Patent Owner's Response are erroneous, as discussed above. Accordingly, it is my opinion that Challenged Claims should be found unpatentable.

77. I reserve the right to supplement my opinions in the future to respond to any arguments or positions that the Patent Owner may raise, taking account of new information as it becomes available to me.

78. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Respectfully submitted,

Dated: April 14, 2023

David Rosen, Ph.D.