IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Douglas et al.	
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Title:	TAGGED BUILD MATERIAL FOR THREE-DIMENSIONAL PRINTING	

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 11,167,464 PURSUANT TO 35 U.S.C. §§ 311-319, 37 C.F.R. § 42

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EXHIBITS

EX1001	U.S. Patent No. 11,167,464 to Douglas et al. ("the '464 patent")
EX1002	Excerpts from the Prosecution History of the '464 patent
EX1003	Declaration of Dr. Michael A. Hickner
EX1004	U.S. Patent Application Publication No. 2006/0091199 to Loughran ("Loughran")
EX1005	RESERVED
EX1006	RESERVED
EX1007	Kaur et al., RFID Technology Principles, Advantages, Limitations & Its Applications, International Journal of Computer and Electrical Engineering, Vol. 3, No. 1, February 2011 ("Kaur")
EX1008	RESERVED
EX1009	U.S. Patent Application Publication No. 2006/0127153 to Menchik et al.
EX1010	RESERVED
EX1011	U.S. Patent No. 6,022,207 to Dahlin et al. ("Dahlin")
EX1012	U.S. Patent Application Publication No. 2007/0077323 to Stonesmith et al.
EX1013	U.S. Patent Application Publication No. 2013/0075954 to Gregory, II et al.
EX1014	U.S. Patent Application Publication No. 2011/0223349 to Scott
EX1015	U.S. Patent Application Publication No. 2002/0171703 to Phillips et al.

EX1016	U.S. Patent Application Publication No. 2010/0192806 to Heugel et al.
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EX1019	Stipulation sent by Petitioner's counsel to Patent Owner's counsel
EX1020	Docket Control Order (Document 34), *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd. et al*., 2:24-cv-00644 (EDTX)
EX1021	Defendant's Motion to Dismiss for Failure to Join Indispensable Party (Document 38), *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd. et al*., 2:24-cv-00644 (EDTX)
EX1022	U.S. Provisional Application No. 61/719,874 ("the '874 Provisional")
EX1023	Evans, Practical 3D Printers (2012)
EX1024	Japanese Patent Application Publication No. JP2013-67018A to Kusama Toshiki, Certified English Translation and Original ("Toshiki")
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LISTING OF CLAIMS

Claim Element	Language
1[p]	A method, comprising:
1[a]	reading data from a tag included on a supply of a build material using a tag sensor in communication with a controller of a three-dimensional printer, the data including at least one property of the build material;
1[b]	determining an operational parameter of a fabrication process using the three-dimensional printer based upon the data, the operational parameter including at least one of a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement;
1[c]	performing a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer; and
1[d]	when the operational parameter is suitable for the three-dimensional printer according to the diagnostic test, controlling operation of the three-dimensional printer during the fabrication process with the controller according to the operational parameter to fabricate an object with the three-dimensional printer.
2	The method of claim 1, wherein the tag includes at least one of a radio frequency identification (RFID) tag, an optically-identifiable tag, a magnetically-identifiable tag, and a mechanical feature of the supply.
3	The method of claim 1, wherein the tag sensor includes at least one of a radio frequency identification (RFID) reader, an optical scanner, a magnetic reader, and a contact point sensor.

Claim Element	Language
4	The method of claim 1, wherein the data includes at least one of a material identification number, a build material type, a build material diameter, an extruder temperature requirement, a build material melting temperature, a build material color, a build material color lot number, a cost per unit of build material, a build material density, a build material tensile strength, a build material viscosity, a build material recycle code, and a build material expiration date.
5	The method of claim 1, wherein the supply includes at least one of a cartridge, a spool, a filament, a number of pellets, and a liquid.
6	The method of claim 1, wherein the tag includes a radio frequency identification (RFID) tag, and the RFID tag is at least one of a passive RFID tag and an active RFID tag.
10	The method of claim 1, wherein the operational parameter is based upon a build material identification number contained in the data.
11	The method of claim 1, wherein the operational parameter further includes at least one of an extruder temperature and a feed rate.
12[p]	A system, comprising:
12[a]	a three-dimensional printer;
12[b]	a coupling adapted to receive a supply of a build material;
12[c]	a tag sensor communicatively associated with the three-dimensional printer, the tag sensor configured to read data from a data tag associated with the supply of the build material, the data including at least one property of the build material;

Claim Element	Language
12[d]	a processor configured to determine an operational parameter of a fabrication process using the three-dimensional printer based upon the data and to perform a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer, the operational parameter including at least one of a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement; and
12[e]	a controller for the three-dimensional printer, the controller configured to, when the operational parameter is suitable for the three-dimensional printer according to the diagnostic test, control operation of the three-dimensional printer during the fabrication process according to the operational parameter to fabricate an object with the three-dimensional printer.
13	The system of claim 12, further comprising a container holding the supply of the build material, wherein the container is configured to connect to the coupling, and wherein the container includes the data tag.
14	The system of claim 13, wherein the container includes at least one of a cartridge and a spool.
15	The system of claim 12, wherein the build material includes at least one of a filament, a number of pellets, and a liquid.
16	The system of claim 12, wherein the processor is included on a remote network resource.
17	The system of claim 12, wherein the processor is included on one or more of the controller and the three-dimensional printer.
18	The system of claim 12, wherein the tag sensor includes at least one of a radio frequency identification (RFID) reader, an optical scanner, a magnetic reader, and a contact point sensor.
19[p]	A method, comprising:

Claim Element	Language
19[a]	reading first data from a tag included on a supply of a build material using a tag sensor associated with a three-dimensional printer, the first data related to the build material;
19[b]	retrieving second data from a data store, the second data including additional data related to the build material;
19[c]	combining the first data and the second data;
19[d]	determining an operational parameter to configure the three-dimensional printer for a fabrication process using the build material based upon the combination of the first data and the second data;
19[e]	performing a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer; and
19[f]	when the operational parameter is suitable for the three-dimensional printer according to the diagnostic test, controlling operation of the three-dimensional printer during the fabrication process according to the operational parameter to fabricate an object with the three-dimensional printer.

Petitioner Shenzhen Tuozhu Technology Co., Ltd. petitions for *Inter Partes* Review ("IPR") of claims 1-6 and 10-19 ("the Challenged Claims") of U.S. Patent No. 11,167,464 ("the '464 patent").

I. REQUIREMENTS FOR IPR

A. Standing

Petitioner certifies that the '464 patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR.

B. Challenge and Relief Requested

Petitioner requests IPR of the Challenged Claims on the grounds below. Dr. Hickner provides supporting explanations in an expert declaration cited throughout this Petition. EX1003, ¶¶26-143.

Ground	Claims	§103 Basis for Rejection
1A	1, 4, 5, 11-17	Dahlin and Menchik
1B	2, 3, 6, 10, 18, 19	Dahlin, Menchik, and Loughran
2	1-6, 10-15, 17-19	Loughran and Toshiki

As discussed below, the '464 patent is not entitled to its provisional application filing date and, as such, the earliest effective filing date of the '464 patent is October 28, 2013 ("Critical Date"). Each of the references in Grounds 1A-2 was published before the Critical Date. Even if the '464 patent was entitled to its earliest alleged priority date (October 29, 2012), each of the references in Grounds 1A-B was published long before the earliest alleged priority date.

Reference	Date	Prior Art At Least Under
Loughran (EX1004)	5/4/2006 (published)	Pre-AIA §102(a) AIA §102(a)(1)
Menchik (EX1009)	6/15/2006 (published)	Pre-AIA §102(a) AIA §102(a)(1)
Dahlin (EX1011)	2/8/2000 (issued)	Pre-AIA §102(a) AIA §102(a)(1)
Toshiki (EX1024)	4/18/2013 (published)	AIA §102(a)(1)

II. THE ’464 PATENT

A. Brief Description

The ’464 patent describes “methods and systems for the automatic detection and acquiring of three-dimensional printer build material characteristics.” EX1001, 1:25-27; EX1003, ¶¶26-28. A “supply of build material such as a spool or cartridge is instrumented with a data tag that includes information about the build material,” and a “three-dimensional printer can read the information from the tag and determine how to use the build material during fabrication of a three-dimensional object.” EX1001, 1:31-35.

FIG. 3 depicts a three-dimensional printer system 300 that includes a three-dimensional printer 306 and a supply 302 of build material 312:

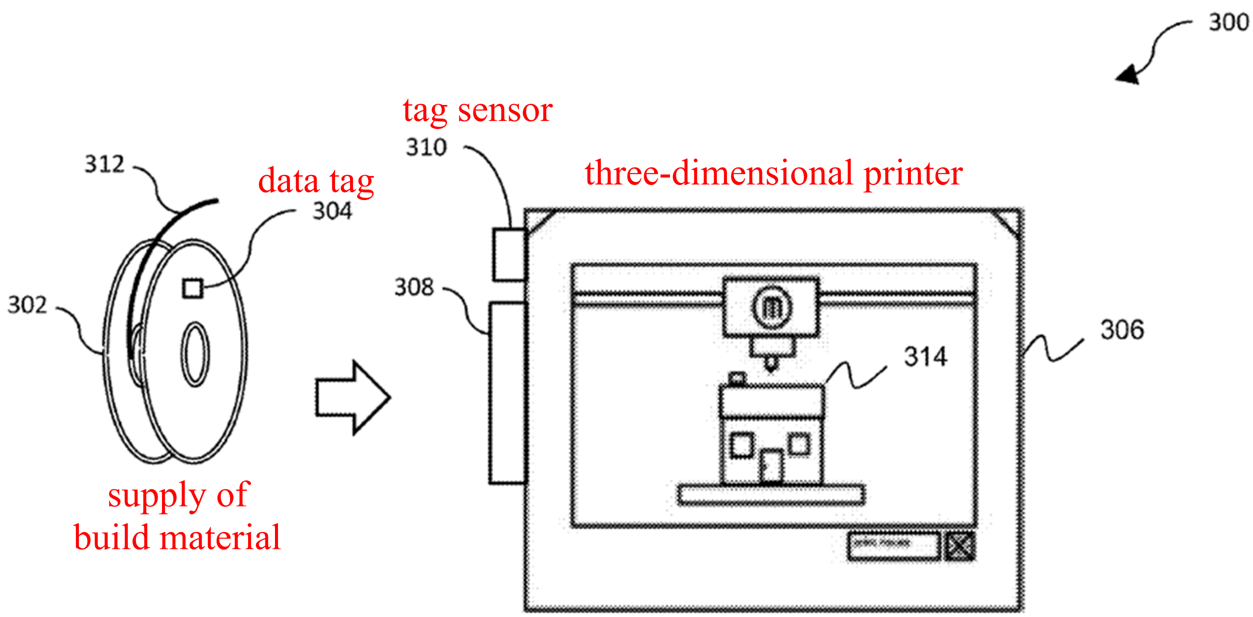


Fig. 3

EX1001, FIG. 3[1], 13:66-14:1. "The supply 302 may include a data tag 304 that stores data providing information on characteristics of the build material 312," and this tag 304 "may be automatically read by a tag sensor 310 on the three-dimensional printer 306." EX1001, 14:31-15:11. "Once the supply 302 has been coupled to the coupling 308 and the tag sensor 310 has read the data tag 304 data, the data may be transmitted to the controller… to determine at least one operational parameter for the three-dimensional printer 306 based on at least one

[1] Annotations and color added to figures unless otherwise noted.

characteristic of the build material 312 for the fabrication of an object 314." EX1001, 15:12-18.

The '464 patent further discloses that "the determination of operational parameters may include preliminary diagnostic tests such as whether the diameter of the build material, size of a build material pellet, build material fluid viscosity, or the like is appropriate for the three-dimensional printer 306. Additional diagnostic test may be performed such as whether the correct build material 312 is provided on the supply 302, whether the correct color or color lot build material 312 is on the supply, or any other appropriate preliminary diagnostic build material test used to determine, as a threshold matter, whether a desired fabrication can be performed with the supply 302." EX1001, 15:54-65.

B. Summary of the Prosecution History

The examination of the '464 patent was terse—including an office action that raised only a §102 rejection based on US8,658,250 (Batchelder). EX1002, 100-106. In response to the §102 rejection, the applicant amended the independent claims to include performing "a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer" and to clarify that controlling the operation of the printer occurred "when the operational parameter is suitable for the three-dimensional printer according to the diagnostic test." EX1002, 133-141. The examiner allowed the claims without expressing any reasons for allowance. EX1002, 191-195.

This examination focused on §102 anticipation by Batchelder was stunted. No office action raised, nor did applicant address in its remarks, any §103 obviousness ground at all or the far more pertinent publications (including Dahlin, Menchik, Loughran, and Toshiki) cited in the Grounds below. As demonstrated below, the predictable obviousness combinations in the Grounds below provided the amended claim elements that the examiner apparently believed to be missing from the prior art. Under these circumstances, review of the ’464 patent is proper and just.

C. Level of Ordinary Skill

A person of ordinary skill in the art at the time of the ’464 patent (“POSITA”) would have had (1) at least a bachelor’s degree in Mechanical Engineering, Computer Engineering, Chemical Engineering, Materials Science, or a related field, and (2) at least two years of research or industry experience in 3D printing or materials used for 3D printing. EX1003, ¶20. Additional experience could substitute for a formal degree or formal training (and vice versa). *Id.*

D. Claim Construction

All claim terms should be construed according to the *Phillips* standard. *Phillips v. AWH Corp*., 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. § 42.100. Given the noticeable overlap between the preferred embodiment of the ’464 patent and the prior art/predictable combinations articulated in Grounds 1A-2, Petitioner submits that no claim terms require a formal construction for purposes of evaluating the prior art and resolving issues this proceeding. *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011); *Google Inc. v. Intellectual Ventures II LLC*, 701 Fed. Appx. 946, 956 (Fed. Cir. 2017) ("do not require construction" for purposes of "resolv[ing] the parties' patentability arguments").

E. Priority Date of the Challenged Claims

Under 35 U.S.C. §119(e), a patent application may rely on the filing date of a provisional application ***only if*** one or more claims have written description support in the provisional application. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). The provisional application must "contain a written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms," 35 U.S.C. §112, ¶1, to enable a POSITA to practice the invention claimed in the non-provisional application. *Id*. Under 35 U.S.C. §112, ¶1, an applicant must "convey with reasonable clarity to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention." *Vas–Cath Inc. v. Mahurkar*, 935 F.2d 1555 (Fed.Cir.1991). "Entitlement to a filing date does not extend to subject matter which is not disclosed, but would be obvious over what is expressly disclosed." *In re Huston*, 308 F.3d 1267 (Fed. Cir. 2002). The written description requirement is not satisfied if the disclosure would lead one to speculate as to "modifications that the inventor might have envisioned, but failed to disclose." *In re Jones*, 10 F. App'x 822 (Fed. Cir. 2001). "The question is not a question of whether one skilled in the art might be able to construct the patentee's device from the teachings of the disclosure … it is a question whether the application necessarily discloses that particular device." *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1571-72 (Fed. Cir. 1997).

Petitioner demonstrates here that all Challenged Claims are not entitled to the filing date of U.S. Provisional Application No. 61/719,874 ("the '874 Provisional") because claims 1-6 and 10-19 do not have written description support in the '874 Provisional. *See Falko-Gunter Falkner v. Inglis*, 448 F.3d 1357 (Fed. Cir. 2006); EX1003, ¶¶29-30. As shown below, the '874 Provisional does not actually or inherently disclose each and every claim element. *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1306-07 (Fed. Cir. 2008). Each of the Challenged Claims requires reading data from a tag (elements 1[a], 12[c], 19[a]), determining an operational parameter based upon the data (elements 1[b], 12[d], 19[d]), performing a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer (elements 1[c], 12[d], 19[e]), and when the operational parameter is suitable for the three-dimensional printer according to the diagnostic test, controlling operation of the three-dimensional printer according to the operational parameter (elements 1[d], 12[e], 19[f]). The ’874 Provisional discloses no such system that performs this method.

For example, the ’874 Provisional disclosure at pages 78-79, paragraphs [0027]-[0028] mentions “diagnostic tests,” but the diagnostic test explicitly described relates to the “diameter of the build material,” which is merely “data describing the build material” and not an “operational parameter” as required by the claims. This disclosure does not describe performing a diagnostic test on “tool instructions” such as “a build platform temperature” or “extrusion temperature.” Thus, this disclosure does not adequately provide written description support for performing a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer (elements 1[c], 12[d], 19[e]) and when the operational parameter is suitable for the three-dimensional printer according to the diagnostic test, controlling operation of the three-dimensional printer according to the operational parameter (elements 1[d], 12[e], 19[f]). EX1003, ¶31.

In another example, the ’874 Provisional disclosure at pages 49-50, paragraphs [0087]-[0088] does not use the term “diagnostic test.” Further, the evaluations described here do not determine whether an operational parameter is suitable for the printer. Specifically, determining whether there is “an object within a working volume” does not disclose determining whether an operational parameter is suitable for the printer because "an object within a working volume" is not an operational parameter. Determining that "a print head is not at a suitable temperature (or is not responding correctly to a heating command)" is not a test of whether the print head temperature, determined based on the tag data, is suitable for the printer and thus does not disclose determining whether an operational parameter, determined based on the tag data, is suitable for the printer (elements 1[c], 12[d], 19[e]). EX1003, ¶32.

With respect to the '874 Provisional at pages 49-50, paragraph [0088], nowhere does the '874 Provisional disclose that the "amount of build material required for the print job" is determined based on the tag data. Therefore, this disclosure does not adequately provide written description support for determining an operational parameter based upon the data (elements 1[b], 12[d], 19[d]) and performing a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer (elements 1[c], 12[d], 19[e]). EX1003, ¶33.

The '874 Provisional's generic disclosure of "a variety of status checks" using "a variety of sensors and other inputs" at page 50, paragraph [0089] is not equivalent to a description of performing a diagnostic test to determine whether the operational parameter, determined based upon the tag data, is suitable for the three-dimensional printer (elements 1[c], 12[d], 19[e]). EX1003, ¶34; *Lockwood*, 107

F.3d at 1572 ("a prior application itself must describe an invention, and do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought" and "the specification must contain an equivalent description of the claimed subject matter").

Regarding the '874 Provisional's disclosure at page 62, paragraph [00129], there is no indication that the test object is fabricated using an operational parameter determined based on the tag data, and therefore the diagnostic function described here does not adequately provide written description support for performing a diagnostic test to determine whether the operational parameter is suitable for the three-dimensional printer (elements 1[c], 12[d], 19[e]). EX1003, ¶35.

Consequently, the '874 Provisional does not actually or inherently disclose each and every element of the Challenged Claims. EX1003, ¶36. The introduction of these features into the claims resulted in the '464 patent claims not being entitled to the provisional application filing date of October 29, 2012, and are, at most, entitled to the filing date of October 28, 2013.

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. GROUND 1A—Claims 1, 4, 5, 11-17 are obvious over Dahlin and Menchik

1. Dahlin

Dahlin "relates to the field of three-dimensional prototype modeling."

EX1011, 1:5-6; EX1003, ¶38. Dahlin's FIG. 1 shows a "rapid prototyping system 10":

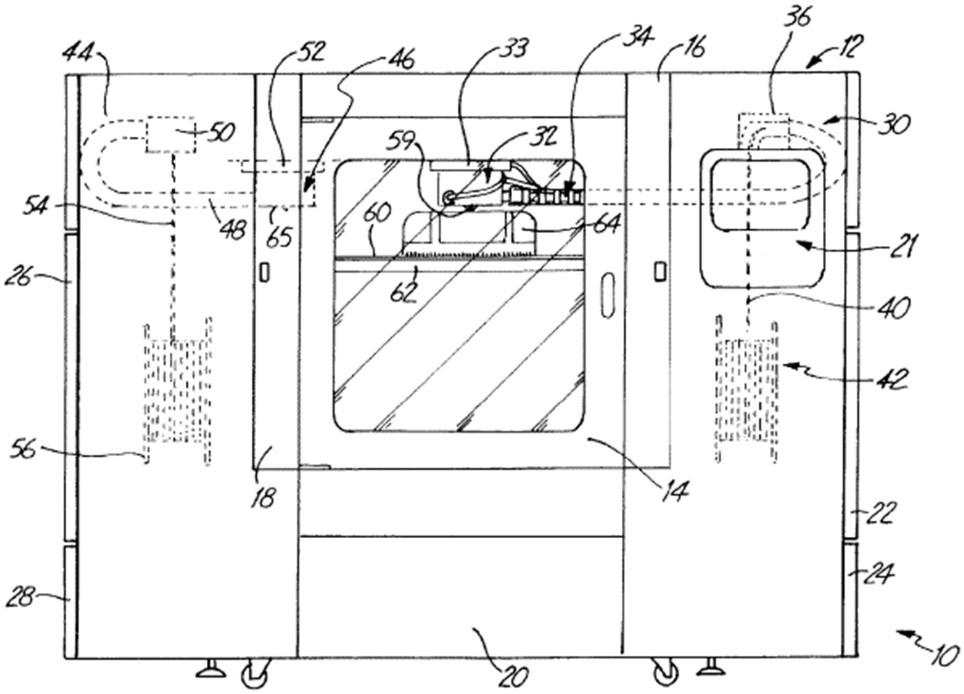


Fig. 1

EX1011, FIG. 1, 2:44-45. In Dahlin, "three-dimensional objects are formed using filament supplied from a spool having an associated circuit for maintaining data regarding type and amount of filament on the spool." EX1011, 1:13-17. Based on the "data regarding the type and amount of filament on the spool," Dahlin's system can diagnose (and notify the operator) "if the type of filament does not match the type of material identified by object specification data or if the amount of filament on the spool is insufficient to create a desired object." EX1011, 1:64-2:2. Specifically, "[a]t the outset of a job, the CPU92 will calculate whether a spool 42 or 56 contains enough filament to complete the job. Operator notification is then provided via touch screen display 21, stating either that the filament is adequate to complete the job, or that the filament spool will need replacement and reloading during the process." EX1011, 5:27-32.

2. Menchik

Menchik discloses "apparatuses and methods useful in three-dimensional object printing." EX1009, [0001], [0006], [0018]; EX1003, ¶¶39-41. Menchik's "FIG. 1 is a block diagram of a 3D printer system 100" that "may include, for example, a controller 105, printing apparatus 140, and one or more three dimensional modeling material supply sources such as cartridge apparatuses 180 or cartridge arrays 190":

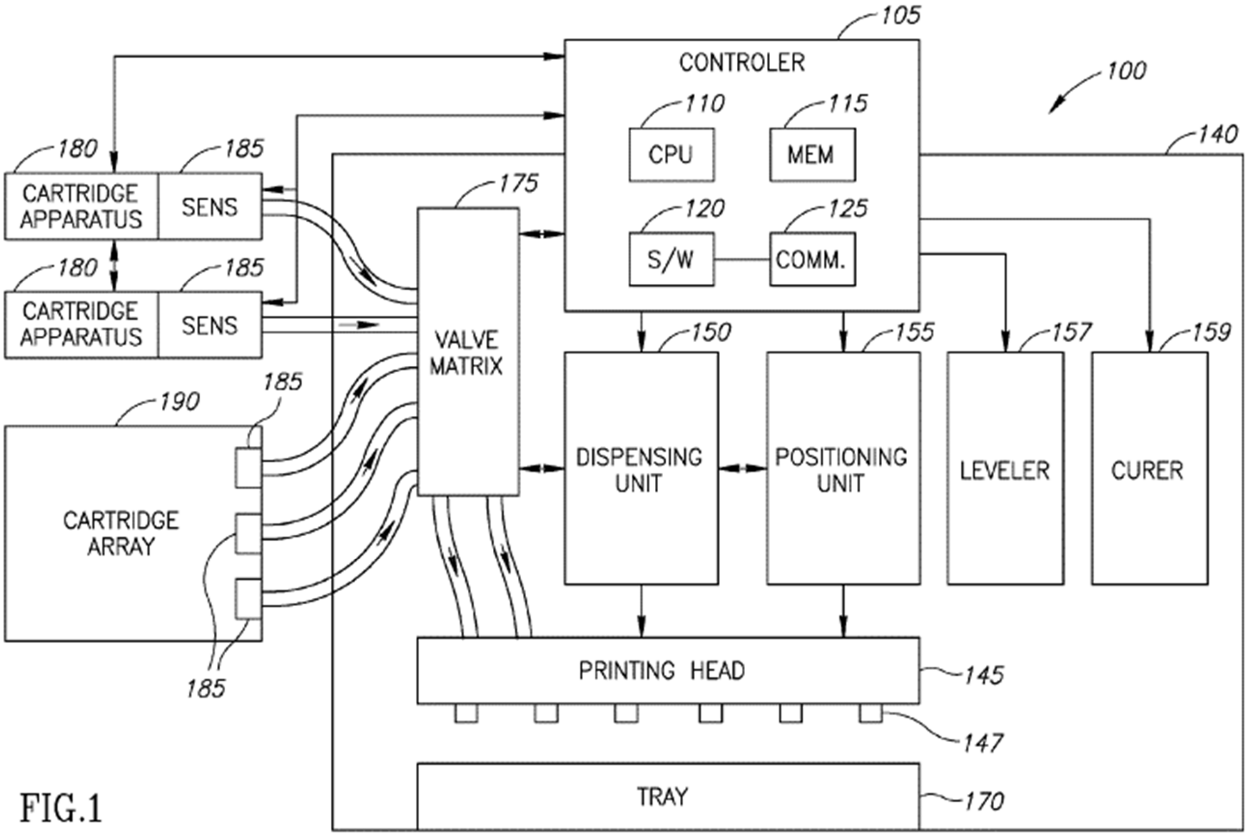


FIG.1

EX1009, FIG. 1, [0020], [0009], [0006].

Menchik's system includes "a memory device such as a memory chip 260… associated with cartridge 250" that stores "information relating to the material stored within cartridge 250, for example, the type of building material in the cartridge bag 300, the materials color, manufacturing date, optimal operation parameters (e.g., recommended jetting temperature), optimum building parameters (e.g., for building or support), and material parameters (e.g., viscosity and surface tension at the recommended temperature etc.)." EX1009, [0035]. "Building material information may include, for example, material density, material mass per volume, and other suitable data from which material status may be computed." *Id.* Menchik's system provides for "management and control of the supply of building materials" by "processing the building material status data to determine parameters of the building material." EX1009, [0006]-[0007]. Menchik processes "data related to the status of building material in one or more supply sources to compute material parameters for building material(s), material required to construct one or more objects, and supply parameters for materials." EX1009, [0027]. Menchik computes "the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object" and determines "whether the amount of modeling and/or support material in the available cartridges is sufficient to complete a three-dimensional object to be built or printed." EX1009, [0048]-[0049], [0046].

3. Dahlin-Menchik Combination

A POSITA would have been motivated to implement Dahlin's system in a manner that employs Menchik's suggestion (e.g., a data tag/readable memory storing optimal operation parameters, optimum building parameters, and material parameters, and the system computing material and supply parameters including the amount of material required for printing a given object) to thereby enable Dahlin's system to determine operational parameters based on data stored in its circuit, including the amount of modeling and support filament required for completing the job, in order to "calculate whether a spool 42 or 56 contains enough filament to complete the job." EX1011, 5:26-37; EX1003, ¶46. A POSITA would have been motivated to apply Menchik's suggestion to Dahlin for multiple reasons. *Id.*

First, a POSITA would have been motivated to apply Menchik's suggestion to Dahlin to beneficially provide "a system for efficiently managing the supply of materials for usage during a printing process." EX1009, [0005]. As Menchik describes, "printing of a given three-dimensional object may require a finite and calculable amount of building material for completion" and thus "[i]t may be advantageous to have a system for efficiently managing the supply of materials for usage during a printing process." EX1009, [0005]. Thus, a POSITA would have found it desirable to implement Dahlin based on Menchik's suggestions such that the spool's data circuit stores optimal operation parameters, optimum building parameters, material parameters, and building material information, and the printer controller determines supply parameters using the information stored in the circuit in order to calculate the amount of material needed for completion and use the finite amount of building materials efficiently. EX1009, [0035], [0049]; EX1003, ¶47.

Second, a POSITA would have been motivated to apply Menchik's suggestion to Dahlin to facilitate Dahlin's ability to "ensure continuous and uninterrupted supply of required material(s) to a 3D printing apparatus" and to "negate the necessity for manual monitoring of materials and on-hand replacement of containers during printing." EX1009, [0017]. Thus, a POSITA would have found it desirable to determine the amount of modeling and support filament required for completing the job, in order to "calculate whether a spool 42 or 56 contains enough filament to complete the job." EX1011, 5:26-37. A POSITA would have been motivated to implement Dahlin's system in this predictable manner to beneficially facilitate Dahlin's ability to provide the operator with the opportunity to respond to the notification before the printing begins by, for example, making modifications to the printing file or replacing the support filament spool with a spool that contains enough support filament to complete the job before printing begins instead of replacing and reloading the spool during the printing process. EX1003, ¶48.

Third, a POSITA would have been motivated to apply Menchik's suggestion to Dahlin to provide a system that uses the optimal operation parameters, optimum building parameters, material parameters, and supply parameters for the materials and the job. A POSITA would have been motivated to implement Dahlin based on Menchik's suggestion to advantageously allow optimal use of the various functions of the printer based on the nature of the materials in the printer and production of a higher quality object. EX1003, ¶49.

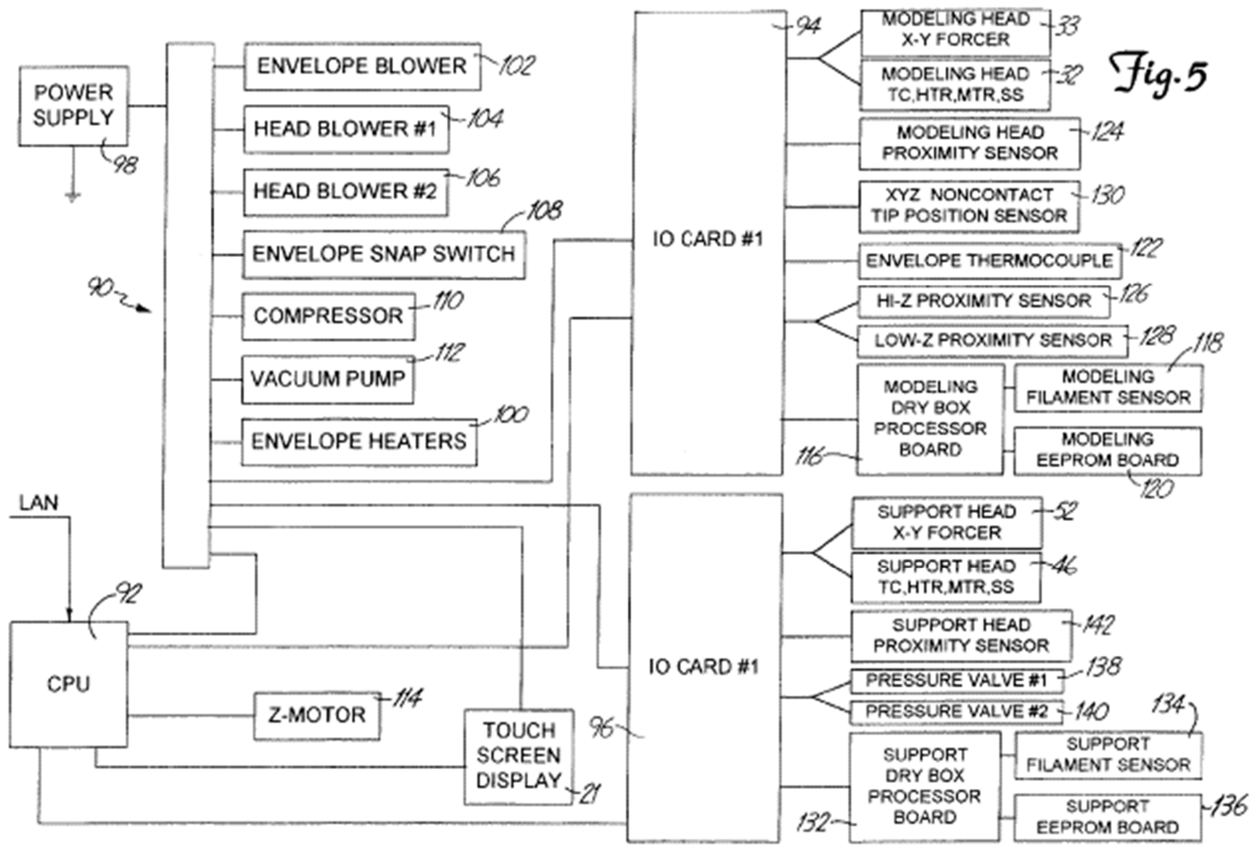
Finally, such an implementation of Dahlin's system based on Menchik's suggested techniques would have been merely the application of known techniques to a known system ready for improvement to yield predictable results. EX1003, ¶50. Indeed, "when a patent 'simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Here, the systems of Dahlin and Menchik are each related to systems for fabricating three-dimensional objects, which is the same as the '464 patent. EX1011, 1:5-6, 2:44-45, 1:13-17; EX1009, [0001], [0006]-[0010], [0018]-[0020], [0035]; EX1001, 2:1-5, 3:21-27. In this context, a POSITA was not an automaton and instead would have possessed ample skill to successfully implement the combination as described above and thus would have reasonably expected success achieving the combination. EX1003, ¶50; *see Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1379 1379-81 (Fed. Cir. 2023) ("a person of ordinary creativity, not an automaton").

4. Claim Element Analysis

(a) Claim 1

Element 1[p]

Dahlin's rapid prototyping system includes an electrical system 90 and a CPU 92 that performs a method to thereby "control the overall operation of the electrical system 90":

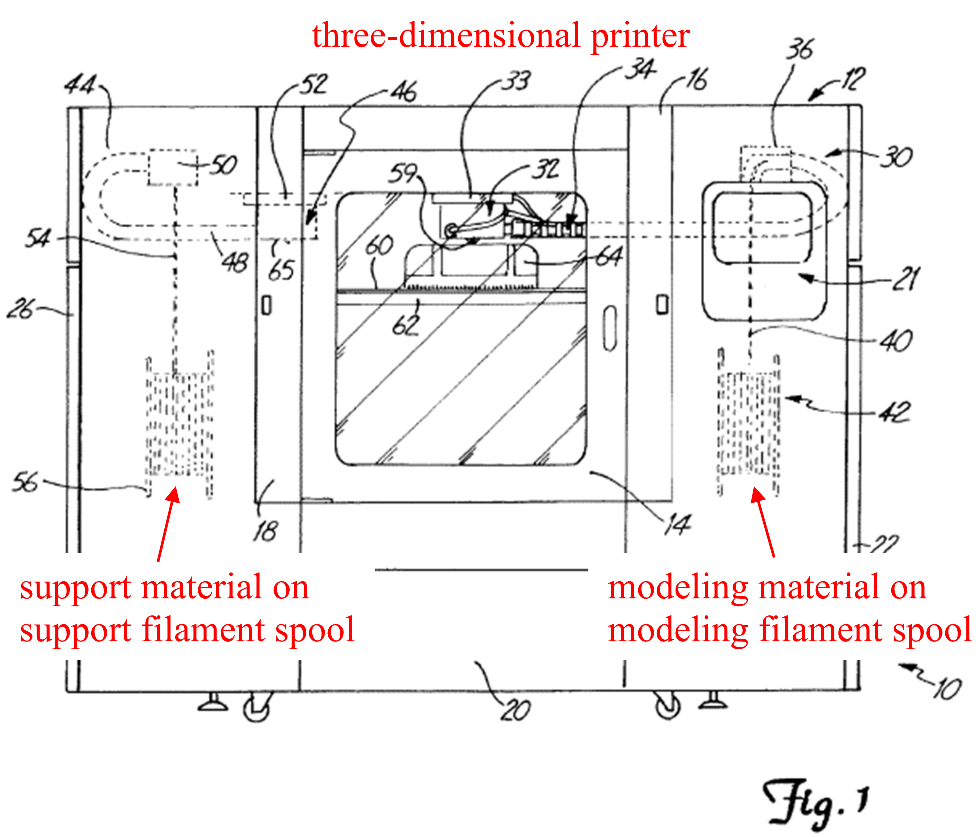


EX1011, FIG. 5, 4:30-34; EX1003, ¶51. For example, the CPU 92 "receives modeling filament data," "calculate[s] whether a spool 42 or 56 contains enough filament to complete the job," and provides "[o]perator notification…, stating either that the filament is adequate to complete the job, or that the filament spool will need replacement and reloading during the process." EX1011, 5:26-37.

Element 1[a]

Dahlin's rapid prototyping system is "for forming three-dimensional objects" and is thus a three-dimensional printer. EX1011, 1:6-21, 3:27-31, 4:17-18, 6:28-39; EX1003, ¶52. Dahlin's FIG. 1 shows a "rapid prototyping system

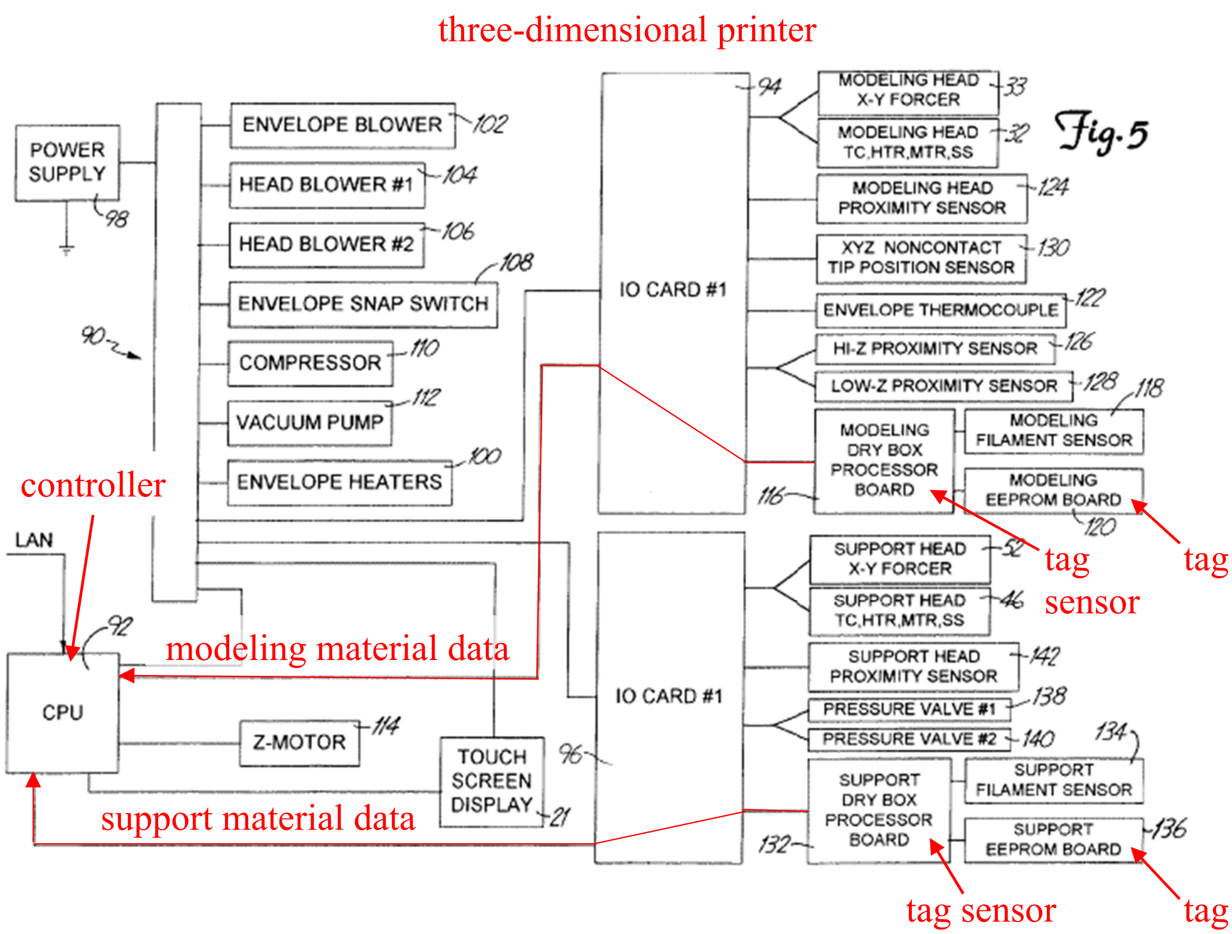
10." EX1011, 2:44-45. During operation of Dahlin's system, "[m]odeling extrusion apparatus 30 receives a filament of modeling material 40 from a modeling filament spool 42 located in a modeling drybox 45," and "[s]upport extrusion apparatus 44 receives a filament of support material 54 from a support filament spool 56 located in a support filament drybox 57." EX1011, 2:60-64, 3:7-11. Each spool has "an associated circuit for maintaining data regarding type and amount of filament on the spool." EX1011, 1:13-17, 1:61-64.



EX1011, FIG. 1.

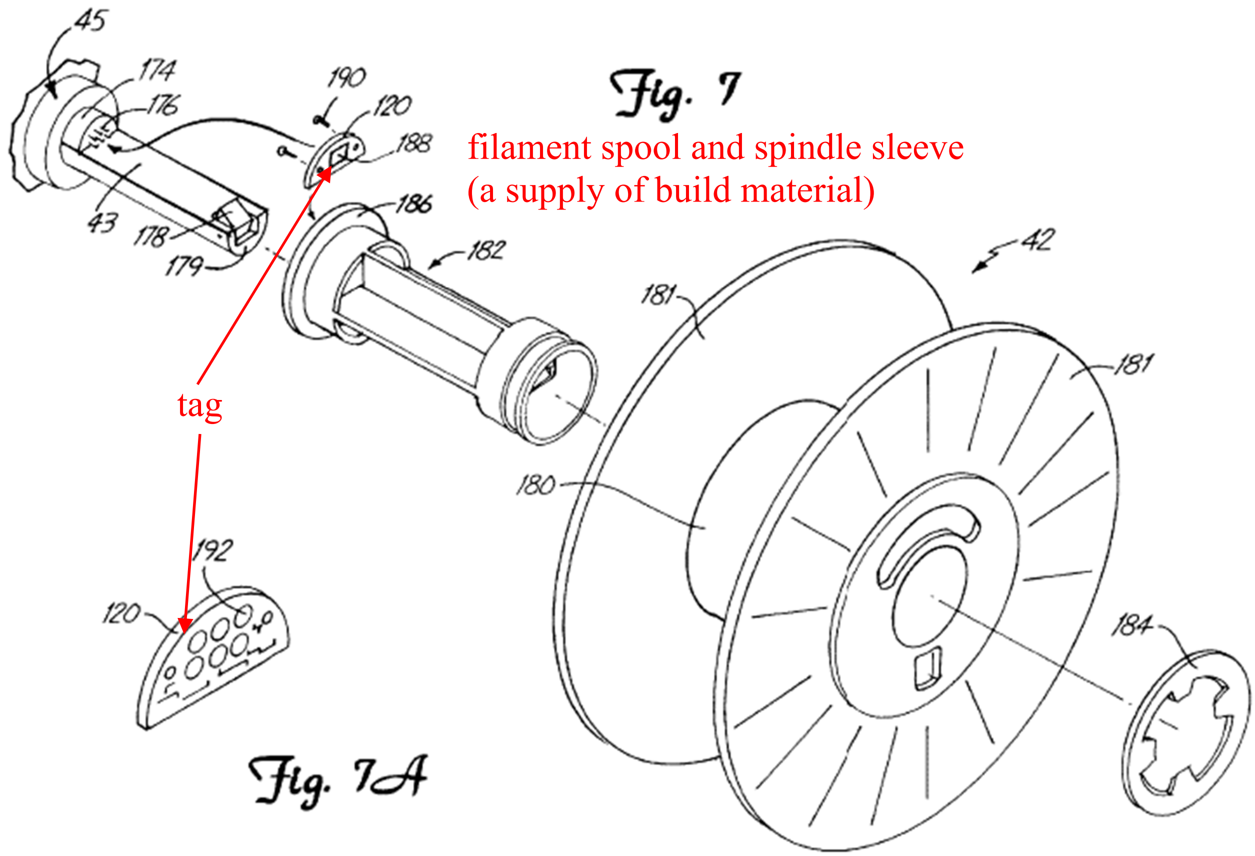
As shown in FIG. 5, Dahlin's rapid prototyping system includes an electrical system 90 that "controls the system 10" and a CPU 92 to "control the overall operation of the electrical system 90." EX1011, 4:30-6:6. Dahlin discloses that a "[m]odeling drybox processor board 116 is mounted inside of modeling filament drybox 45" and "receives data concerning the modeling filament from… a modeling EEPROM board 120, which is a circuit board carrying an electronically readable and writeable device (EEPROM 188, shown in FIG. 7) attached to modeling material filament spool 42. EEPROM board 120 acts as an electronic tag with a variety of functions. It informs the control system 90 of the type of filament that is on the spool and of the lineal feet of filament on the spool." EX1011, 5:3-14. "CPU 92 receives the modeling filament data from IO card 94," which "monitors data concerning modeling material filament spool 42 through communications with a modeling drybox processor board 116." EX1011, 5:1-43. Dahlin's system 10 also includes "support drybox processor board 132" that "receives data concerning the support filament from… a support EEPROM board 136, attached to support material filament spool 56. EEPROM board 136 acts as an electronic tag, in the same manner as EEPROM board 120. CPU 92 receives the support filament data from support processor board 132." EX1011, 5:55-64; EX1003, ¶53.

The modeling drybox processor board 116 is a tag sensor that reads data from the EEPROM board 120, which "acts as an electronic tag," attached to modeling material filament spool 42 (a supply of build material). EX1011, 5:3-14. The support drybox processor board 132 is a tag sensor that reads data from the EEPROM board 136, which "acts as an electronic tag," attached to support material filament spool 56 (a supply of build material). EX1011, 5:55-64. As shown in FIG. 5 below, the CPU 92 (controller) receives the modeling material data and the support material data through communication with the modeling drybox processor board 116 (tag sensor) and support drybox processor board 132 (tag sensor), respectively:



EX1011, FIG. 5. The data read from the tag includes "type of filament that is on the spool" and "the lineal feet of filament on the spool," which are properties of the build material. EX1011, 5:3-14, Abstract, 1:13-17, 1:64-2:2, 11:26-28, 12:13-14, 12:41-46; EX1003, ¶54.

"FIG. 7 shows a detailed exploded view of the filament spool and spindle." EX1011, 8:43-44. "The mechanical configuration of the filament spool and spindle is identical for both the modeling filament and the support filament." EX1011, 8:44-46. The spindle sleeve 182 holds an "EEPROM board 120" that "carries EEPROM 188." EX1011, 8:65-66. "When filament spool 42 is manually inserted onto spool holder 43, electrical contact between EEPROM board 120 and drybox processor board 116 is made through the connector 190." EX1011, 9:12-15. As shown in FIG. 7, the EEPROM board 120 (tag) is included on filament spool (supply of build material):



EX1011, FIGS. 7, 7A; EX1003, ¶55.

Element 1[b]

As previously described, Dahlin teaches that the EEPROM board 120 serves as "an electronic tag with a variety of functions" to communicate information about the filament of material to the control system 90. EX1011, 5:11-12. Additionally, Dahlin also more broadly suggests the type of information (about the filament of material) that is "desirable" for communicating to the control system. EX1011, 1:40-47. Namely, Dahlin expressly suggests, for such a "filament feed" system, that it is "desirable for the control system to know" not only "the type of material" that is coupled to the printer, but also "the proper extrusion parameters for dispensing the material" and describes a known prior art example of a "memory device" that "serves as an electronic tag which informs the control system of the type of material that is in the cassette, the proper extrusion parameters for dispensing the material, the current number of rods in the cassette, and the cassette serial number." EX1011, 1:40-58. Thus, based on Dahlin's express suggestion in column 1 and by the relatively late time frame leading up to 2013, a POSITA would have been motivated to implement Dahlin's "electronic tag with a variety of functions" (col. 5:11-12) to store "proper extrusion parameters" (col. 1:40-47; operational parameters), thereby advantageously enabling Dahlin's control system 90 (col. 4:30-5:53) to determine such operational parameters by simply reading them from the electronic tag and to fabricate objects using those proper extrusion parameters for that particular filament material. EX1003, ¶56.[2]

Additionally or alternatively, as discussed above in Section III.A.3, a

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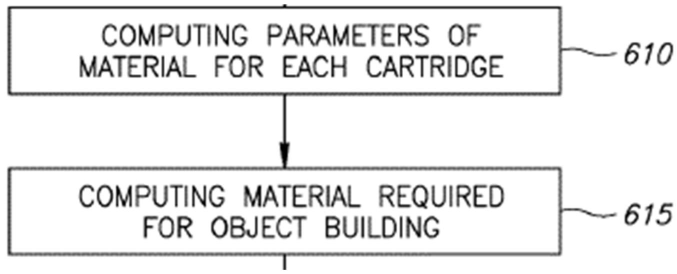
[2] This implementation of Dahlin aligns with the '464 patent's example where "the controller may make the determination of operational parameters using only the data from the data tag 304. For example, the data tag 304 may explicitly specify an extruder temperature and the controller may use the extruder temperature as an operational parameter." EX1001, 15:26-31.

POSITA would have also been motivated to implement Dahlin's system in a manner that employs Menchik's suggestion (e.g., the memory device storing optimal operation parameters, optimum building parameters, material parameters, and building material information, and the controller computing material and supply parameters including the amount of material required for printing a given object) to thereby enable Dahlin's system to determine the amount of support material required for printing a given object (operational parameter) based on building material information stored in its tag. EX1003, ¶57. Menchik's FIG. 6 shows that at "block 610 various parameters of the materials within the various cartridges may be computed by the controller, for example, the amount of material of each type and/or color presently available in each cartridge, by, for example, utilizing the data provided by the respective sensors and respective memory chips attached to the respective cartridges." EX1009, [0047]. Additionally, at "block 615 the printer controller may compute, for example, the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object. The printer controller may also compute the expected order and quantity of uptake and deposition of each type of material into the printing apparatus, for the printing or construction of a given object":



EX1009, FIG. 6 (partial), [0048]. Indeed, as explained above, Menchik provides evidence of the conventional practice long before 2013 for a three-dimensional printing system to use "a memory device such as a memory chip 260" (associated with a supply of 3D printer material) that stores a greater variety of "information relating to the material stored within cartridge 250." EX1009, [0035]. Additionally, Menchik discloses that "[o]ther suitable data may be stored. Building material information may include, for example, material density, material mass per volume, and other suitable data from which material status may be computed." EX1009, [0035]. "For example, material status data may indicate types... of building material in one or more supply sources." EX1009, [0027]. "Memory chip 260 may, for example, store and/or record information relating to the material stored within cartridge 250, for example, the type of building material in the cartridge bag 300." EX1009, [0035]. Menchik also suggested that 3D printer system could then advantageously provide for "management and control of the supply of building materials" by "processing the building material status data to determine parameters of the building material" such as "the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object." EX1009, [0006]-[0007], [0048]. Menchik further confirmed it was an ordinary option before 2013 for the controller to compute "material parameters for building material(s), material required to construct one or more objects, and supply parameters for materials." EX1009, [0027]. Thus, for the reasons articulated above, the predictable Dahlin-Menchik combination would have readily determined an operational parameter of a fabrication process using the 3D printer ("the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object") based on such data read from the electronic tag (e.g., building material information). *Supra* Sections III.A.2, III.A.3.

Dahlin further discloses that based on the "data regarding the… amount of filament on the spool," Dahlin's system "notifies the operator… if the amount of filament on the spool is insufficient to create a desired object." EX1011, 1:64-2:2. Specifically, "CPU 92 receives the modeling filament data," and "calculate[s] whether a spool 42 or 56 contains enough filament to complete the job," and provides "[o]perator notification…, stating either that the filament is adequate to complete the job, or that the filament spool will need replacement and reloading during the process." EX1011, 5:26-37. Additionally, "CPU 92 receives the support filament data…, and uses it to provide operator information in the same manner as described above with respect to the modeling filament." EX1011, 5:55-64. A POSITA would have been motivated to implement Dahlin so that the CPU 92 also determines the amount of modeling and support filament required for completing the job in order to "calculate whether a spool 42 or 56 contains enough filament to complete the job." EX1011, 5:26-37; EX1003, ¶58. A POSITA would have understood that the amount of support filament required for completing the job is an operational parameter specifying a support structure requirement. *Id.*

Indeed, Menchik suggests such an implementation of Dahlin's system by disclosing that the "controller may compute, for example, the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object" so that the "controller may determine whether the amount of modeling and/or support material in the available cartridges is sufficient to complete a three-dimensional object to be built or printed." EX1009, [0048]-[0049]. A POSITA would have been motivated to implement Dahlin's system in a manner that employs Menchik's suggestion (e.g., the controller computing the amount of support material required for printing a given 3D object) to thereby enable Dahlin's system to determine the amount of support filament required for completing the job (an operational parameter specifying a support structure requirement) in order to "calculate whether a spool… 56 contains enough filament to complete the job." EX1011, 5:26-37;

EX1003, ¶59.

Element 1[c]

As discussed above in element 1[b], in the predictable modification of Dahlin as suggested by Menchik described above, Dahlin's CPU 92 determines the amount of support filament required for completing the job (operational parameter specifying a support structure requirement) in order to "calculate whether a spool… 56 contains enough filament to complete the job" and provide "[o]perator notification…, stating either that the filament is adequate to complete the job, or that the filament spool will need replacement and reloading during the process." EX1011, 5:26-37, 5:55-64, 1:64-2:2; EX1003, ¶60. A POSITA would have understood that calculating whether a spool contains enough support filament to complete the job is a diagnostic test to determine whether the amount of support filament required (operational parameter specifying a support structure requirement) is suitable for the printer to complete the print job. *Id.*; *see supra* Section III.A.3.

Element 1[d]

Dahlin discloses that the CPU 92 performs the diagnostic test described above in element 1[c] "[a]t the outset of a job" and before "the system enters a build state during which it creates the three-dimensional object." EX1011, 5:26-37, 6:28-39. "In forming an object, the modeling material is deposited in one or more layers on the substrate 60. The support material is then deposited in one or more layers over the modeling material. The object is then built up on the support material, using a plurality of layers of modeling and/or support material." EX1011, 8:14-20. Additionally, Menchik discloses that "[d]uring the printing process the controller may continue to monitor, for example, the status of the building material(s) remaining in one or more respective cartridge bags, the total amount of building material of each type still required to complete the construction of one or more three dimensional objects, and the length of time remaining before each respective cartridge may need to be replaced by another cartridge in line etc." EX1009, [0050]. Based on Dahlin's and Menchik's disclosures describing continuing the printing process and monitoring the amount of support material required during the printing process after determining that the amount of support material required to complete the job (operational parameter) is suitable, a POSITA would have understood that when the amount of support filament required for completing the job (operational parameter specifying a support structure requirement) is suitable for the printer to complete the print job, the CPU 92 controls operation of the printer during fabrication of the object according to the amount of support filament required to complete the job (operational parameter) by, e.g., monitoring the amount of support material to complete construction (operational parameter) and replacing the cartridge during the fabrication process.

EX1003, ¶61.

(b) Claim 4

Supra, elements 1[a] and 1[b]. EX1011, 5:3-14 ("type of filament"); EX1009, [0035] ("type of building material," "the materials color," "recommended jetting temperature"); EX1003, ¶62.

(c) Claim 5

Supra, element 1[a]. EX1011, 2:60-64 ("filament of modeling material 40 from a modeling filament spool 42"), 3:7-11 ("filament of support material 54 from a support filament spool 56"); EX1003, ¶63.

(d) Claim 11

As discussed above in element 1[b], a POSITA would have been motivated to apply Dahlin's suggestion (e.g., the tag informing the control system of the proper extrusion parameters for dispensing the material) to thereby enable Dahlin's system to determine the proper extrusion parameters (operational parameters) for dispensing the material by reading the proper extrusion parameters stored in the tag and to fabricate objects using the proper extrusion parameters for dispensing the material. EX1011, 1:51-58, 1:40-47, EX1003, ¶64. Dahlin further discloses that "material is selected and its temperature is controlled so that it solidifies upon extrusion or dispensing onto the base." EX1011, 1:10-13. In Dahlin, "the filaments of modeling and support materials are each a solid material which can be heated relatively rapidly above its solidification temperature, and which will very quickly solidify upon a small drop in temperature after being dispensed from the extrusion head." EX1011, 3:45-50. CPU 92 "sends and receives signals associated with modeling extrusion head 32," which includes "a heater 220 (HTR)" and "sends and receives signals to and from support extrusion head 46, which includes… a heater (HTR). EX1011, 4:58-67, 5:45-52. "Heater 220… heat[s] the tube to a temperature just above the melting temperature of the filament." EX1011, 10:14-16. A POSITA would have found it obvious that the proper extrusion parameters stored in the tag includes an extruder temperature. EX1003, ¶64.

Indeed, Menchik suggests such an implementation of Dahlin's system by suggesting storing optimal operation parameters including a recommended jetting temperature in a memory chip included on a cartridge of building material. EX1009, FIG. 2, [0030], [0035], [0037], [0043]. Specifically, Menchik discloses "[m]emory chip 260 may, for example, store and/or record information relating to the material stored within cartridge 250, for example, the type of building material in the cartridge bag 300, the material's color, manufacturing date, optimal operation parameters (e.g., recommended jetting temperature), optimum building parameters (e.g., for building or support), and material parameters (e.g., viscosity and surface tension at the recommended temperature etc.) etc." EX1009, [0035].

Menchik's "[c]ontroller 105 may receive data from one or more material supply sources, and control the supply of building material to printing apparatus 140, for example, by controlling the extraction or flow of materials from the printing material sources, such as printing cartridges." EX1009, [0027], [0007]. A POSITA would have understood that the recommended jetting temperature is an extruder temperature. EX1003, ¶65.

A POSITA would have been motivated to implement Dahlin based on Dahlin's and Menchik's suggestions such that the proper extrusion parameters stored in the tag include an extruder temperature to thereby enable Dahlin's system to determine the proper extruder temperature for dispensing the filament by reading the extruder temperature stored in the tag and to control the heater to heat the tube to a temperature for dispensing the filament in order to fabricate objects using the filament. EX1003, ¶66.

(e) Claim 12

Element 12[p]

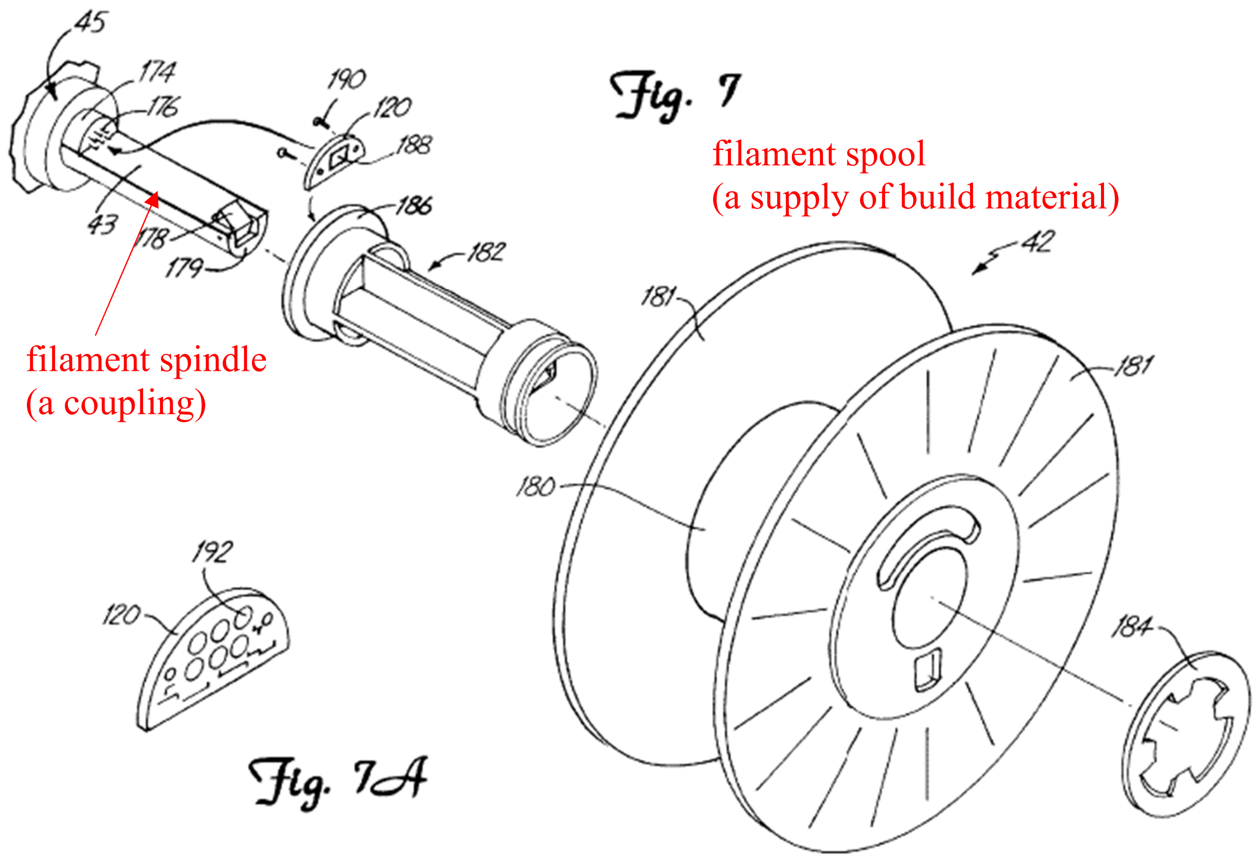
Supra, element 1[p] and 1[a]. EX1003, ¶67.

Element 12[a]

Supra, element 1[a]. EX1003, ¶68.

Element 12[b]

Dahlin's "FIG. 7 shows a detailed exploded view of the filament spool and spindle shown in FIGS. 2 and 3:"



EX1011, FIG. 7, 8:43-44; EX1003, ¶69. "The mechanical configuration of the filament spool and spindle is identical for both the modeling filament and the support filament." EX1011, 8:44-46. "Spindle 43 extends horizontally from drybox 45" of the rapid prototyping system. EX1011, 8:49-50. A "sleeve 182… fits within barrel 180 for receiving spindle 43," and the "filament spool 42 is manually inserted onto spool holder 43." EX1011, 8:54-59, 9:12-15. The spindle 43 is a coupling adapted to receive the filament spool 42 (a supply of build material). EX1003, ¶69.

Element 12[c]

Supra, element 1[a]. EX1003, ¶70.

Element 12[d]

As discussed above in element 1[a], Dahlin's rapid prototyping system includes an electrical system 90 that "controls the system 10" and a CPU 92 to "control the overall operation of the electrical system 90." EX1011, 4:30-6:6. The CPU (Central Processing Unit) is a processor. EX1009, [0026] ("Processor 110 may include conventional devices, such as a Central Processing Unit (CPU)."); EX1001, 4:1-21 ("All such computing devices and environments are intended to fall within the meaning of the term 'controller' or 'processor'."); EX1003, ¶71. As discussed above in Section III.A.3 and elements 1[b] and 1[c], the predictable application of Menchik's suggestion to Dahlin's system provides a CPU or controller configured to determine the proper extrusion parameters, optimal operation parameters, optimum building parameters, material parameters, and supply parameters (operational parameters) based on the data stored in the tag, and to calculate whether a spool contains enough support filament to complete the job (diagnostic test) to determine whether the amount of support filament required (operational parameter specifying a support structure requirement) is suitable for the printer to complete the print job. *Id.*

Element 12[e]

As discussed above in element 1[d] (discussing operations controlled by CPU 92), Dahlin's CPU 92 controls operation of the printer during fabrication of the object according to the amount of support filament required to complete the job (operational parameter specifying a support structure requirement) when the amount of support filament required for completing the job is suitable for the printer to complete the print job. EX1003, ¶72; EX1001, 4:1-21 ("All such computing devices and environments are intended to fall within the meaning of the term 'controller' or 'processor'."). Additionally, Menchik describes a "controller 105" that includes "a Central Processing Unit (CPU)." EX1009, [0026]. A POSITA would have found it obvious to implement Dahlin's CPU 92 in a controller as suggested by Menchik to beneficially provide a printer that determines, tests, and uses the operational parameter for a fabrication process without the need for another external device to provide the operational parameter and test result to the printer. EX1003, ¶72. Indeed, the language of claim 17 encompasses such an implementation. EX1001, 24:61-64.

(f) Claim 13

As discussed above in elements 1[a] and 12[b], Dahlin describes "a modeling filament spool 42" and "a support filament spool 56," and each spool is coupled to a spindle (coupling) of the printer and has "an associated circuit for maintaining data regarding type and amount of filament on the spool." EX1011, 2:60-64, 3:7-11, 1:13-17, 1:61-64, 8:43-59, 9:12-15, FIG. 7; EX1003, ¶73. Indeed, the '464 patent discloses that the terms "supply," "container," and "spool" are used interchangeably: "The supply 302 may include any suitable container for build material 312, such as a spool of build material, a cartridge of filament, or a container of bulk material such as pellets, or a container of liquid, as well as combinations of these for a multi-modal printer." EX1001, 14:19-24.

(g) Claim 14

Supra, element 1[a]. EX1003, ¶74.

(h) Claim 15

Supra, element 1[a]. EX1003, ¶75.

(i) Claim 16

Dahlin discloses that "the design of a three-dimensional object 64 is input to CPU 92 via a LAN network connection (shown schematically in FIG. 5) utilizing CAD software such as QUICKSLICE® from Stratasys, Inc., which sections the object design into multiple layers to provide multiple-layer data corresponding to the particular shape of each separate layer." EX1011, 6:29-35. Thus, Dahlin contemplates that its rapid prototyping system communicates with a remote network resource, which includes a processor executing CAD software, that provides the multi-layer data for fabricating the object. EX1003, ¶76. A POSITA would have found it obvious to implement Dahlin such that the processor included on the remote network resource determines an operational parameter and performs the diagnostic test. *Id.*

Indeed, Menchik suggests such an implementation by disclosing that "a separate unit, such as a personal computer or workstation… may provide some control or data storage capability." EX1009, [0021]. Specifically, "[c]ontroller 105 may include a CAD system," "may utilize Computer Object Data (COD) representing an object or a model, such as CAD data in Stereo Lithography (STL) format," "may convert such data to instructions for the various units within 3D printer system 100 to print a 3D object" and "may be located… outside of printing apparatus 100. Controller 105 may be located outside of printing system 100 and may communicate with printing system 100, for example, over a wire and/or using wireless communications." EX1009, [0024]. "Controller 105 may be included within, or may include, a computing device such as a personal computer, a desktop computer, a mobile computer, a laptop computer, a server computer, or workstation (and thus part or all of the functionality of controller 105 may be external to 3D printer system 100)." EX1009, [0026]. As discussed in Section III.A.3 and elements 1[b] and 1[c], Menchik discloses that this controller in a separate unit determines operational parameters. EX1003, ¶77.

Based on Menchik's teaching, a POSITA would have found it an obvious design choice to implement the functionality of determining an operational parameter and performing a diagnostic test in a processor that is included on a remote network resource. *KSR*, 550 U.S. at 421 ("a person of ordinary skill has good reason to pursue the known options within his or her technical grasp."). A POSITA would have been motivated to provide such an implementation to beneficially enable the CAD software executing on the processor of the remote system to determine the operational parameters and to calculate whether a spool contains enough support filament to complete the job (diagnostic test) to determine whether the amount of support filament required (operational parameter specifying a support structure requirement) is suitable for the printer to complete the print job before providing the design to the CPU of the rapid prototyping system. EX1003, ¶78. Doing so would allow the user of the CAD software to generate a design using specific materials more quickly and efficiently. *Id.* This would have included allowing the user of the remote CAD system to make design choices based on the received material parameters and determined operational parameters. Such an implementation also would have reduced the computational strain on the local CPU 92, thus allowing the three-dimensional printer to be operated with a smaller, and less expensive CPU. *Id.*

(j) Claim 17

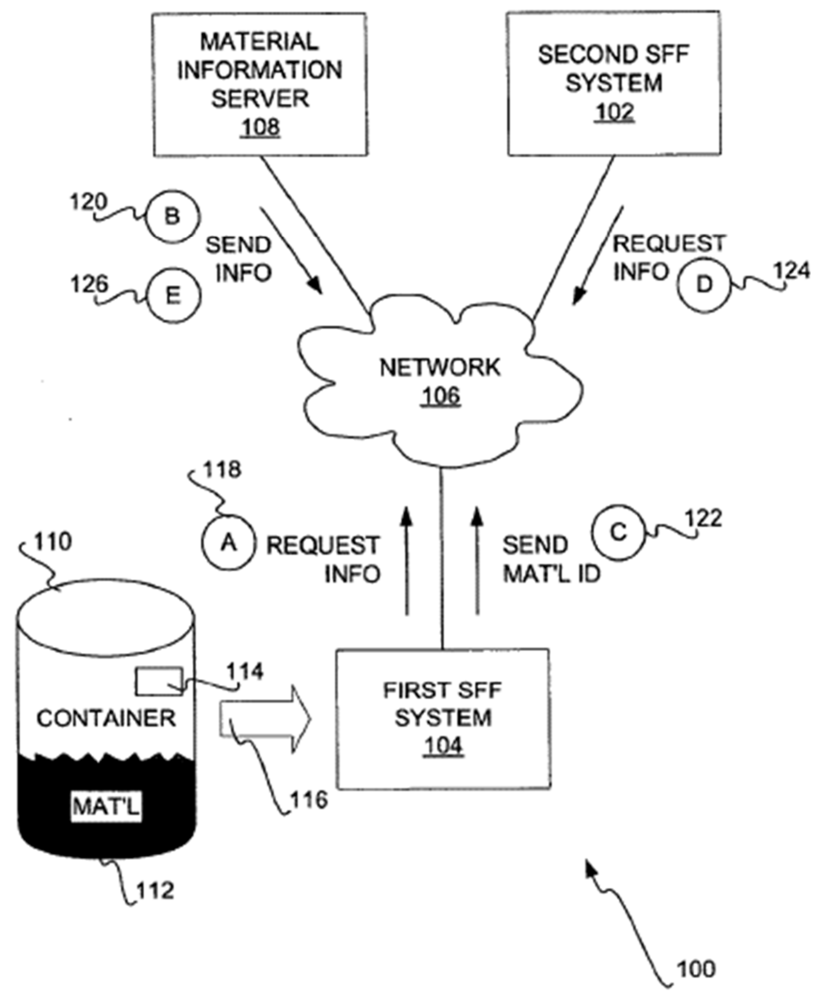
Supra, elements 12[d] and 12[e]. EX1003, ¶79.

B. GROUND 1B—Claims 2, 3, 6, 10, 18, and 19 are obvious over Dahlin, Menchik, and Loughran

1. Loughran

Loughran describes "a solid freeform fabrication (SFF) system." EX1004, Abstract, [0001]; EX1003, ¶¶42-44. Loughran's FIG. 1 shows a diagram of a system 100 including a SFF system 104 that fabricates SFF jobs received from client system 102:

FIG 1



EX1004, FIG. 1, [0005], [0012]-[0013], [0044], [0049]-[0050].

Loughran discloses that the "material container 110 contains a tag 114 that includes a material identifier." EX1004, [0020]. Loughran discloses that "in one embodiment, the tag 114 may be a radio-frequency identifier (RFID) tag that returns a signal encoding the unique material identifier of the material 112 when sent a transmitting signal. The second SFF system 104 in such an embodiment detects the signal, and decodes the unique material identifier from the signal." EX1004, [0021]. To that end, Loughran's SFF system 104 includes a "communication mechanism 506" that "receives the unique material identifier from the material container 110 containing the material 112 and that is presented to the second SFF system 104. The mechanism 506 may include an RF reader to detect signals returned by the tag 114 of the container 110, where the tag 114 is an RFID tag." EX1004, [0047].

2. Dahlin-Menchik-Loughran Combination

A POSITA would have found it obvious and straightforward to implement each of Dahlin's drybox processor boards 116 and 132 as a RF reader and to include each of Dahlin's EEPROM boards 120 and 136 in a RFID tag. EX1003, ¶80. A POSITA would have been motivated to apply Loughran's suggestion to Dahlin to provide this functionality for multiple reasons. *Id.*

First, a POSITA would have been motivated to use RFID technology in Dahlin's system because a number of advantages suggest applying RFID for added value of identification. EX1003, ¶81. Compared to conventional semiconductor memory which requires the printer to have electrical contact with the memory to transfer data to the printer (EX1015, [0026]), RFID requires no contact, so tag placement is less constrained. EX1007, 3. Additionally, tags are less sensitive to adverse conditions such as dust, chemicals, physical damage, etc. *Id.*

Second, the use of RFID technology for Dahlin's drybox processor board and EEPROM board would have been an obvious design choice. EX1003, ¶82; *KSR*, 550 U.S. at 421 ("a person of ordinary skill has good reason to pursue the known options within his or her technical grasp."). A number of publications establish that use of RFID tags to store data regarding printing materials was well-known at the time of the '464 patent. EX1007; EX1004, [0020]-[0021], [0047]; EX1012, [0017], [0024]; EX1013, [0008], [0063]; EX1014, [0040]; EX1015, [0020], [0022]-[0026]; EX1016, [0049], [0054], [0068]-[0069].

Such an implementation of Dahlin's system based on Loughran's suggested techniques would have been merely the application of known techniques to a known system ready for improvement to yield predictable results. *KSR*, 550 U.S. at 417. Here, the systems of Dahlin and Loughran are each related to storing and using build material data for fabricating three-dimensional objects, which is the same as the '464 patent. EX1004, [0020]-[0021], [0033], [0047]; EX1011, 5:3-14, 5:55-64, Abstract, 1:13-17, 1:40-2:2, 11:26-28, 12:13-14, 12:41-46; EX1001, 1:25-27, 1:31-35, 14:31-15:18. In this context, a POSITA was not an automaton and instead would have possessed ample skill to successfully implement the combination as described above and thus would have reasonably expected success achieving the combination. EX1003, ¶83.

3. Claim Element Analysis

(a) Claim 2

As discussed above in element 1[a], Dahlin discloses that modeling drybox processor board 116 is a tag sensor that reads data from the EEPROM board 120, which "acts as an electronic tag," attached to modeling material filament spool 42 (a supply of build material) and support drybox processor board 132 is a tag sensor that reads data from the EEPROM board 136, which "acts as an electronic tag," attached to support material filament spool 56 (a supply of build material). EX1011, 5:3-14, 5:55-64. As discussed above in Section III.B.2, a POSITA would have found it obvious and straightforward to implement each of Dahlin's drybox processor boards 116 and 132 as a RF reader and to include each of Dahlin's EEPROM boards 120 and 136 in a RFID tag. EX1003, ¶84. Indeed, Loughran suggests such an implementation of Dahlin's system by disclosing a build material container containing a RFID tag, and a RF reader to detect signals returned by the RFID tag. EX1004, [0020]-[0021], [0047]. A POSITA would have understood that a RFID tag includes a memory chip such as an EEPROM (electrically erasable programmable read-only memory) and associated circuit board such as an EEPROM board. EX1003, ¶84; EX1007, 3.

(b) Claim 3

Supra, claim 2. EX1003, ¶85.

(c) Claim 6

As discussed above in claim 2, POSITA would have found it obvious to include Dahlin's EEPROM board in an RFID tag that is read by an RFID reader. EX1003, ¶86. A POSITA would have understood that an RFID tag is either passive or active because RFID tags are of one of two types: passive or active. EX1007, 1.

(d) Claim 10

Dahlin describes a prior art system with a "rod dispensing cassette having an electronically readable and writeable memory device that provides data to the control system." EX1011, 1:48-51. "The memory device serves as an electronic tag which informs the control system of the type of material that is in the cassette, the proper extrusion parameters for dispensing the material, the current number of rods in the cassette, and the cassette serial number." EX1011, 1:51-58, 1:40-47. A POSITA would have been motivated to apply Dahlin's suggestion (e.g., the tag informing the control system of the cassette serial number) to thereby enable Dahlin's system to use the cassette serial number to determine additional information regarding the material not stored on the tag. *Id.*, EX1003, ¶87.

Loughran also suggests such an implementation of Dahlin's system by disclosing using a unique material identifier to request information regarding the material from a material information server over a network. EX1004, [0022],

[0031] (example in which the material identifier is a number). In Loughran, such information may include parameters of the material, including "melting temperature, storage temperature, minimum feature size, horizontal and vertical shrinkage rates, material lifetime, inter-layer delay time, and amount of ultraviolet (UV) light required per layer." EX1004, [0024], [0002]. Menchik also describes "[b]uild material information" that includes "material density, material mass per volume, and other suitable data from which material status may be computed." EX1009, [0035]. A POSITA would have been motivated to apply Loughran's suggestion (e.g., using a material identifier to request information regarding the material not stored on the tag, including minimum feature size and horizontal and vertical shrinkage rates) to thereby enable Dahlin-Menchik's system to determine the amount of support filament required for completing the job (an operational parameter specifying a support structure requirement) based on material parameters including minimum feature size, horizontal and vertical shrinkage rates, and material density retrieved using the material identifier or serial number. EX1011, 5:26-37; EX1009, [0048]-[0049]; EX1004, [0024], [0002]; EX1003, ¶88. A POSITA would have been motivated to provide such an implementation in order to accurately calculate the amount of support filament required for completing the job. *Id.* Such an implementation also would have allowed information regarding a material to be updated, even after the material has been sold, without needing to update or replace each individual tag. *Id.*

(e) Claim 18

Supra, claim 2. EX1003, ¶89.

(f) Claim 19

Element 19[p]

Supra, element 1[p]. EX1003, ¶90.

Element 19[a]

Supra, element 1[a] and claim 10. EX1003, ¶91.

Element 19[b]

Supra, claim 10. EX1003, ¶92.

Element 19[c]

Supra, element 1[a] and claim 10. EX1003, ¶93.

Element 19[d]

Supra, element 1[b] and claim 10. EX1003, ¶94.

Element 19[e]

Supra, element 1[c]. EX1003, ¶95.

Element 19[f]

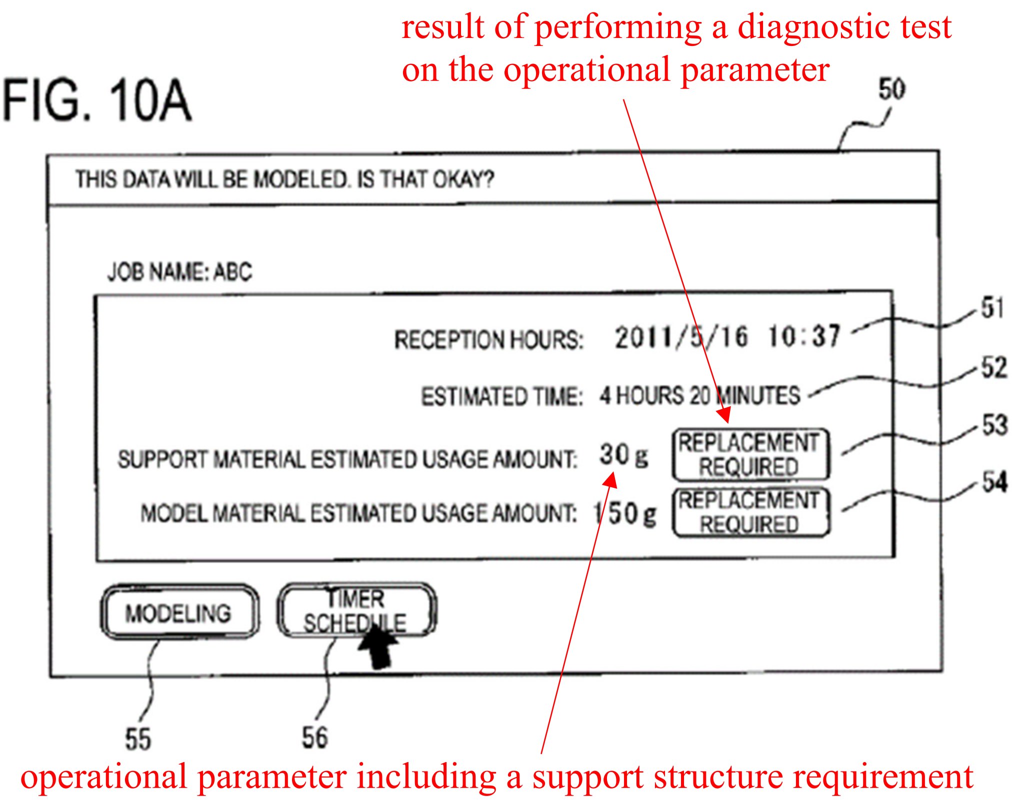
Supra, element 1[d]. EX1003, ¶96.

C. GROUND 2—Claims 1-6, 10-15, and 17-19 are obvious over Loughran in view of Toshiki

1. Toshiki

Toshiki relates a "three-dimensional modeling device," e.g., "an inkjet modeling device." EX1024, [0026]; EX1003, ¶45. Toshiki discloses that the three-dimensional modeling device includes "remaining amount detecting unit 405" and "a tank replacement determining unit 406." EX1024, [0100], [0013]. "The remaining amount detecting unit 405 detects the remaining amount of the modeling material in the modeling material storage tank, and outputs the detection result to the tank replacement determining unit 406." EX1024, [0109]. "Specifically, the remaining amount of model material M in each model material cartridge 13M and the remaining amount of support material S in each support material cartridge 13S are detected." *Id.* "The tank replacement determining unit 406 determines whether or not the modeling material storage tank needs to be replaced while performing model processing on the basis of the remaining amount detected by the remaining amount detecting unit 405, and outputs the determination result to the display unit 122. The determination of whether or not the tank needs to be replaced is made by comparing the current remaining amount of the model material M and the support material S with the cumulative amount of the modeling material to be used in model processing." EX1024, [0110], [0139], [0015], [0017]. "The display unit 122 displays the determination result by the tank replacement determining unit 406 on the screen at least before model processing is started," and "if it is determined that the support material cartridge 13S or the model material cartridge 13M must be replaced during model processing, a message is displayed indicating that the tank needs to be replaced":

FIG. 10A



EX1024, FIG. 10A, [0111], [0121]. "With this configuration, the determination result of whether or not the tank needs to be replaced is displayed before performing model processing, so the user can recognize in advance whether or not the modeling material storage tank needs to be replaced during model processing." EX1024, [0014], [0023], [0009]-[0010]. "Therefore, the user can start model processing after replenishing the modeling material by replacing the modeling material storage tank that is estimated to require replacement." EX1024, [0123], [0183].

2. Loughran-Toshiki Combination

A POSITA would have been motivated to implement Loughran's system in a manner that employs Toshiki's suggestion (e.g., comparing the current remaining amount of the material in the cartridges with the cumulative amount of the modeling material to be used in modeling process, and displaying the determination result, including an indication that the tank needs to be replaced, on a display screen before modeling process is started) to thereby enable Loughran's system to determine the amount of the modeling material to be used in the modeling process and provide the user with a notification either that the amount of material in the cartridges is adequate for the modeling process or that the cartridge will need replacement and reloading during the modeling process. EX1024, [0110]-[0111], [0121], [0139], [0015], [0017] FIG. 10A.EX1011, 5:26-37; EX1003, ¶97. A POSITA would have been motivated to apply Toshiki's suggestion to Loughran for multiple reasons. *Id.*

For example, a POSITA would have been motivated to apply Toshiki's suggestion to Loughran to "ensure continuous and uninterrupted supply of required material(s) to a 3D printing apparatus" and to "negate the necessity for manual monitoring of materials and on-hand replacement of containers during printing." EX1009, [0017]. Thus, a POSITA would have found it desirable to determine "based on expected usage of material and actual availability of materials, …the length of time remaining until one or more cartridges may be expected to empty, and should therefore be replaced" and to display the relevant information on a computer screen as information included in the operator notification. EX1009, [0049]. A POSITA would have been motivated to implement Loughran's system in this predictable manner to beneficially provide the operator with the opportunity to respond to the notification before the printing begins by, for example, making modifications to the printing file or replacing the support material cartridge with a cartridge that contains enough support material to complete the job before printing begins instead of replacing and reloading the cartridge during the printing process. EX1024, [0014], [0023], [0009]-[0010], [0123], [0183]; EX1003, ¶98.

Such an implementation of Loughran's system based on Toshiki's suggested techniques would have been merely the application of known techniques to a known system ready for improvement to yield predictable results. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Here, the systems of Loughran and Toshiki are each related to systems for fabricating three-dimensional objects, which is the same as the '464 patent. EX1004, [0001], [0013], [0016]; EX1024, [0026]; EX1001, 2:1-5, 3:21-27. In this context, a POSITA was not an automaton and instead would have possessed ample skill to successfully implement the combination as described above and thus would have reasonably expected success achieving the combination. EX1003, ¶99; *see Intel Corp. v. PACT XPP Schweiz*

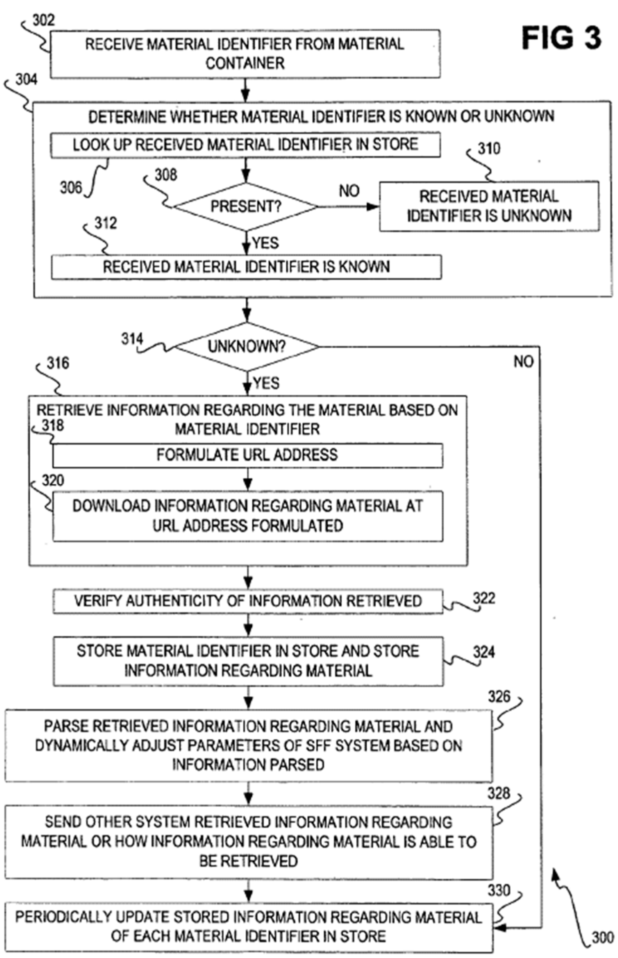
AG, 61 F.4th 1373, 1379 1379-81 (Fed. Cir. 2023) ("a person of ordinary creativity, not an automaton").

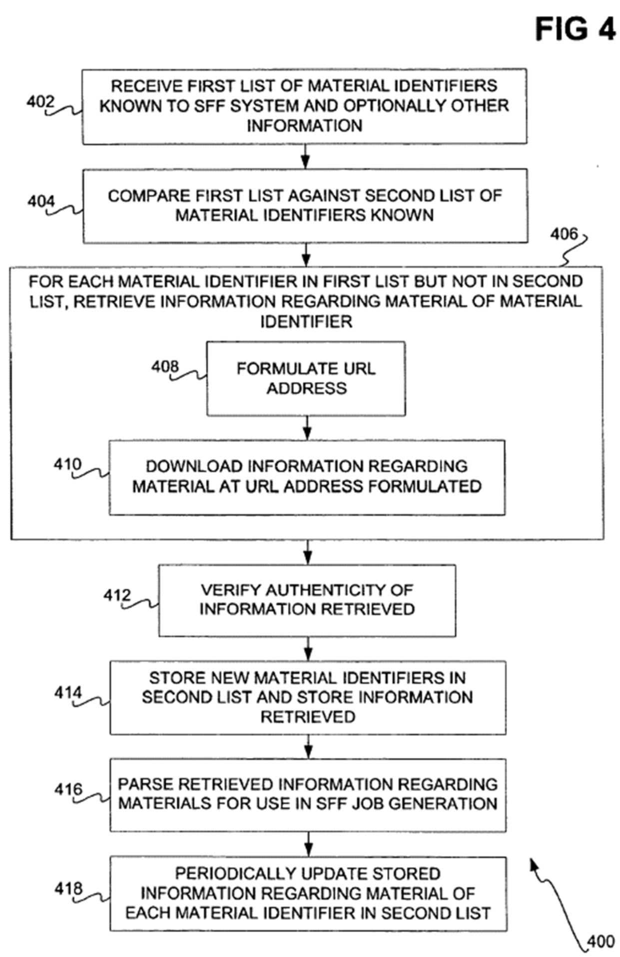
3. Claim Element Analysis

(a) Claim 1

Element 1[p]

Loughran's FIGS. 3 and 4 each show "a method performable by an SFF system":



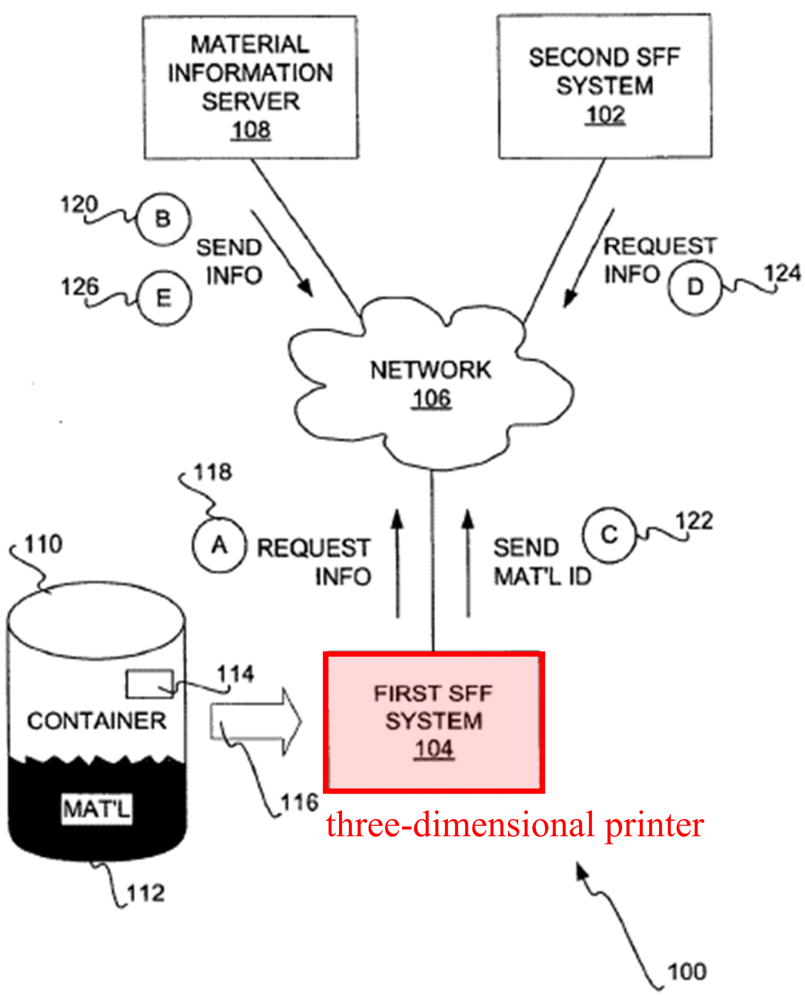


EX1004, FIGS. 3 and 4, [0007], [0032], [0040]; EX1003, ¶100.

Element 1[a]

Loughran's FIG. 1 shows a system 100 including a SFF system 104:

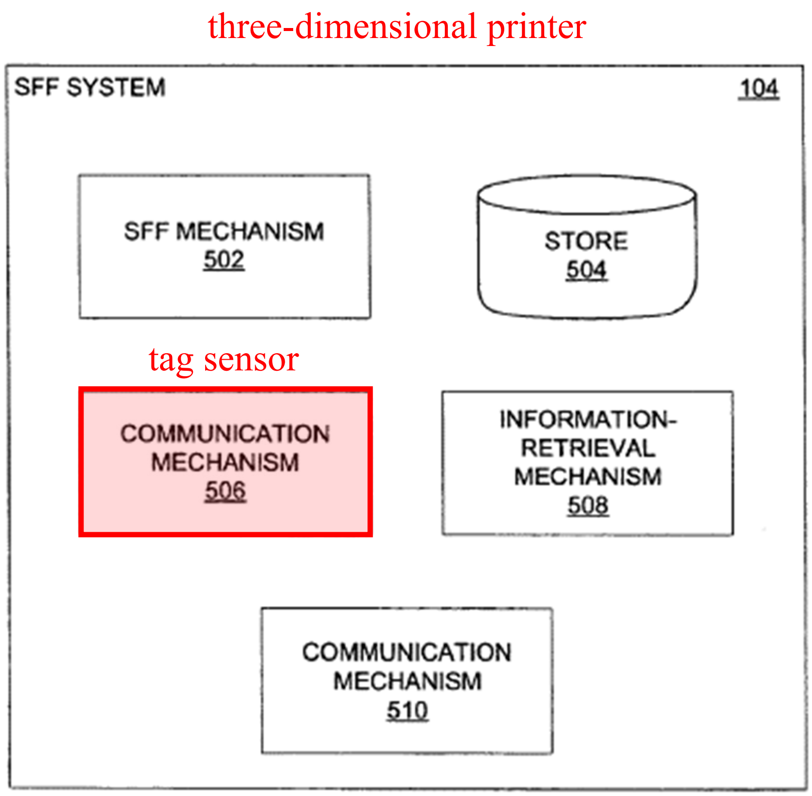
FIG 1



EX1004, FIG. 1, [0001], [0005], [0012]. Loughran's "SFF system 104 fabricates physical objects from SFF fabrication jobs in a layer-by-layer manner." EX1004, [0013]-[0019], [0045]. The SFF system 104 is a three-dimensional printer. EX1003, ¶101.

The SFF system 104 includes a tag sensor in the form of "communication mechanism 506" that "receives the unique material identifier from the material container 110 containing the material 112 and that is presented to the second SFF system 104. The mechanism 506 may include an RF reader to detect signals returned by the tag 114 of the container 110, where the tag 114 is an RFID tag. The mechanism 506 may further include a bar code reader to scan a bar code of the tag 114, where the tag 114 is a bar code tag." EX1004, [0047]. The SFF system 104 also includes an "information-retrieval mechanism 508" that "retrieves from the material information server 108 over the network 106 the information regarding the material 112 contained in the material container 110" and a "SFF mechanism 502" that "dynamically adjust[s] its parameters based on this information so that physical objects can be fabricated from the material 112." EX1004, [0048], [0045]. Loughran discloses that the "mechanisms 502, 506, and 508 may each be hardware or a combination of hardware and software." EX1004, [0044].

FIG 5

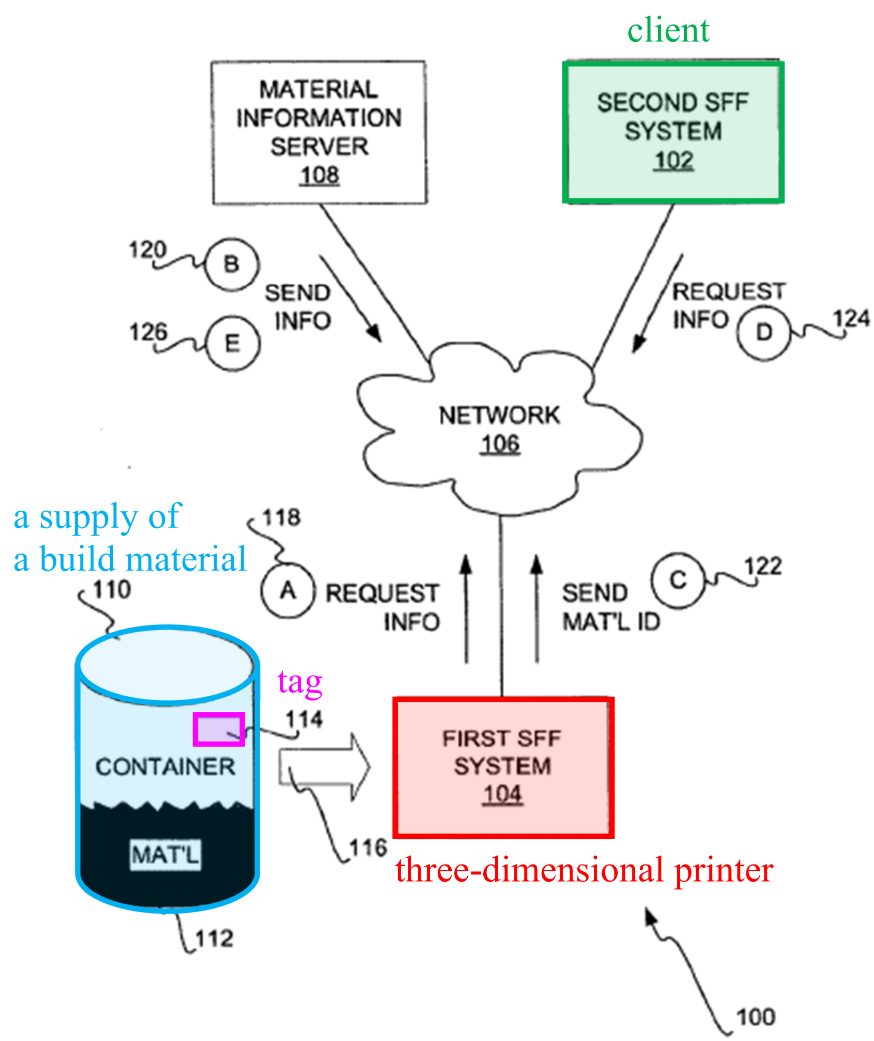


EX1004, FIG. 5; EX1003, ¶102.

The SFF system 104 performs a method that is "implemented as one or more computer program parts of a computer program stored on a computer-readable medium" where the SFF system 104 "receives the material identifier from the tag 114 of the material container 110 (302)," "retrieves information regarding the material 112… based on the material identifier (316)," "parses the retrieved information regarding the material 112 to, for instance, extract parameters regarding the material 112, and dynamically adjusts its own parameters based on parameters extracted (326)" "so that physical objects can be properly fabricated from the material 112." EX1004, [0032]-[0037]. Based on Loughran's disclosure, a POSITA would have understood or found obvious that Loughran's SFF system 104 includes hardware implementing a controller in communication with the tag sensor and executing the computer program to perform the described method. EX1003, ¶103.

Loughran's FIG. 1 shows "a material container 110 containing a material 112 from which physical objects can be fabricated at the second SFF system 104 in accordance with SFF fabrication jobs generated at the [client] system 102 is introduced into the second SFF system 104, as indicated by the arrow 116":

FIG 1



EX1004, FIG. 1, [0020]. The material container 110 containing material 112 is a supply of build material and is coupled to the SFF system 104 (three-dimensional printer) through introduction of the material container 110 into the SFF system 104. EX1003, ¶104.

Loughran discloses that the "material container 110 contains a tag 114 that includes a material identifier." EX1004, [0020]. "[T]he tag 114 may be a radio-frequency identifier (RFID) tag that returns a signal encoding the unique material identifier of the material 112 when sent a transmitting signal" or "a bar code tag having a bar code encoding the unique material identifier of the material 112." EX1004, [0021]. Loughran discloses that "the material identifier 204 of the material 112 retrieved from the tag 114 of the material container 110 may be '101785'." EX1004, [0031]. The material identifier is a material identification number, which is a property of the build material. EX1003, ¶¶105-106. Indeed, the '464 patent discloses that the tag stores data that "may include at least one of a material identification number…." EX1001, 14:56-15:3.

Element 1[b]

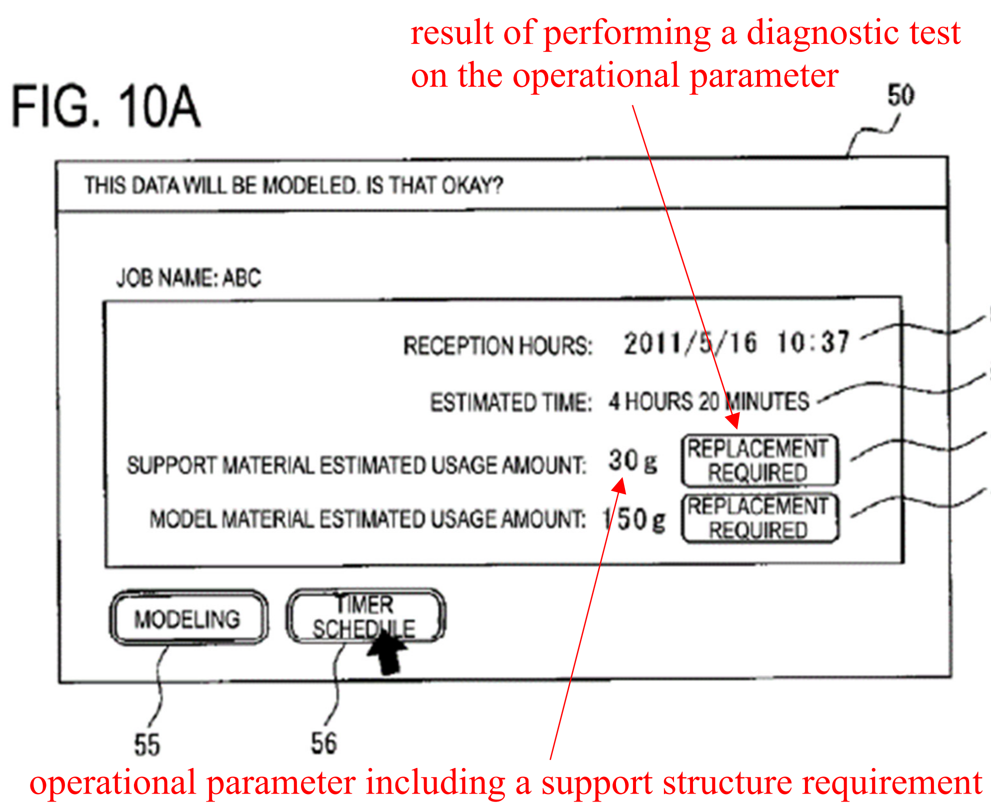
As discussed in 1[a], Loughran's SFF system 104 "receives the material identifier from the tag 114 of the material container 110 (302)," "retrieves information regarding the material 112 from the material information server 108 over the network 106, based on the material identifier (316)," "parses the retrieved information regarding the material 112 to, for instance, extract parameters regarding the material 112, and dynamically adjusts its own parameters based on parameters extracted (326)" "so that physical objects can be properly fabricated from the material 112." EX1004, [0032]-[0037], [0045], [0048]. Loughran discloses that "the information retrieved by the second SFF system 104 regarding the material 112 may include information… by which the second SFF system 104 is automatically and dynamically adjusted for utilization with the material 112. Such information may include parameters of the material 112, including, but not limited to, melting temperature, storage temperature, minimum feature size, horizontal and vertical shrinkage rates, material lifetime, inter-layer delay time, and amount of ultraviolet (UV) light required per layer, among other parameters." EX1004, [0024]. "These parameters may include the operating temperature that the second SFF system 104 needs to achieve to melt the material, the temperature that the second SFF system 104 needs to maintain to store the material, the length of time to wait after one layer of the material has been fabricated before processing the next layer, and so on." EX1004, [0025]. A POSITA would have understood that Loughran's parameters are operational parameters of a fabrication process and are retrieved based on the material identification number (tag data including at least one property of the build material). EX1003, ¶107.

Additionally, Toshiki discloses "modeling parameters such as the type of modeling material, the thickness of the modeling material layer, scanning speed, and the like." EX1024, [0029]. A POSITA would have found it obvious to implement Loughran's parameters that are retrieved based on the material identification number to include modeling parameters such as the type of modeling material, the thickness of the modeling material layer, and the scanning speed, as suggested by Toshiki. EX1003, ¶108. Such an implementation would have beneficially provided additional information for conducting a successful fabrication process, as discussed below. *Id.*

Toshiki discloses that the three-dimensional modeling device (three-dimensional printer) calculates "an estimated amount of modeling material to be used in the modeling process" and "the amount of modeling material used can be estimated on the basis of modeling data including modeling parameters such as the thickness of the modeling material layer and the scanning speed." EX1024, [0095], [0085], [0015]. "The estimated amount of modeling materials used is made up of an estimated amount of model material M used and an estimated amount of support material S used, each of which is calculated on the basis of the modeling data." EX1024, [0090]. A POSITA would have been motivated to implement Loughran so that the SFF system 104 also determines the amount of model material and support material to be used in the modeling process based on modeling parameters that are retrieved using the material identification number, based on Loughran's and Toshiki's suggestions. EX1003, ¶109; *supra* Section III.C.2. In the predictable combination of Loughran and Toshiki, a POSITA would have understood that the amount of support material to be used in the modeling process is an operational parameter specifying a support structure requirement and is determined based on modeling parameters that are retrieved using the material identification number (tag data including at least one property of the build material). *Id.*

Element 1[c]

Toshiki discloses that the three-dimensional modeling device includes "remaining amount detecting unit 405" and "a tank replacement determining unit 406." EX1024, [0100], [0013]. "The remaining amount detecting unit 405 detects the remaining amount of the modeling material in the modeling material storage tank, and outputs the detection result to the tank replacement determining unit 406." EX1024, [0109]. "Specifically, the remaining amount of model material M in each model material cartridge 13M and the remaining amount of support material S in each support material cartridge 13S are detected." *Id.* "The estimated amount of modeling materials used is made up of an estimated amount of model material M used and an estimated amount of support material S used, each of which is calculated on the basis of the modeling data. In addition, a cumulative usage amount is calculated on the basis of the modeling data by adding up the estimated usage amount of the model material M and the support material S required to form each slice layer and the estimated usage amount in the purging process." EX1024, [0090]. "The tank replacement determining unit 406 determines whether or not the modeling material storage tank needs to be replaced while performing model processing on the basis of the remaining amount detected by the remaining amount detecting unit 405, and outputs the determination result to the display unit 122. The determination of whether or not the tank needs to be replaced is made by comparing the current remaining amount of the model material M and the support material S with the cumulative amount of the modeling material to be used in model processing." EX1024, [0110], [0139], [0015], [0017]. "The display unit 122 displays the determination result by the tank replacement determining unit 406 on the screen at least before model processing is started," and "if it is determined that the support material cartridge 13S or the model material cartridge 13M must be replaced during model processing, a message is displayed indicating that the tank needs to be replaced":



EX1024, FIG. 10A, [0111], [0121]; EX1003, ¶110. "With this configuration, the determination result of whether or not the tank needs to be replaced is displayed before performing model processing, so the user can recognize in advance whether or not the modeling material storage tank needs to be replaced during model processing." EX1024, [0014], [0023], [0009]-[0010]. "Therefore, the user can start model processing after replenishing the modeling material by replacing the modeling material storage tank that is estimated to require replacement." EX1024, [0123], [0183].

In the predictable modification of Loughran as suggested by Toshiki, Loughran's SFF system 104 compares the current remaining amount of the model material M and the support material S with the cumulative amount of the modeling material to be used in model processing and displays the determination result, including an indication that the tank needs to be replaced, on a display screen before model processing is started. EX1024, [0110]-[0111], [0121], [0139], [0015], [0017] FIG. 10A; EX1003, ¶111. A POSITA would have understood that determining whether the modeling material storage tank needs to be replaced while performing model processing is a diagnostic test to determine whether the amount of support material to be used in the modeling process (operational parameter specifying a support structure requirement) is suitable for the printer to complete the print job. *Id.*; *see supra* Section III.C.2.

Element 1[d]

Toshiki discloses that the three-dimensional modeling device performs the diagnostic test described above in element 1[c] "before model processing is started" "so the user can recognize in advance whether or not the modeling material storage tank needs to be replaced during model processing." [0111], [0121], [0014], [0023], [0033], [0009]-[0010]. "Therefore, the user can start model processing after replenishing the modeling material by replacing the modeling material storage tank that is estimated to require replacement." EX1024, [0123], [0183]; EX1003, ¶112.

With respect to controlling operation of the printer, Loughran's SFF system 104 includes "SFF mechanism 502" that "fabricates a physical object directly from the CAD information of a SFF fabrication job received from the [client] system 102, in a layer-by-layer manner.… The SFF mechanism 502 can fabricate the physical object from the material 112, since the parameters of the second SFF system 104 are dynamically adjustable based on the information regarding the material 112." EX1004, [0045], [0048]; EX1003, ¶113.

Similarly, Toshiki's three-dimensional modeling device also includes "modeling processing unit 402" that "performs model processing to form a model target object on the modeling stage 112 on the basis of the modeling data in the modeling job storage unit 401." EX1024, [0103]. In Toshiki, a "modeling job is composed of modeling data and the corresponding attribute information, and is stored in association with identification information of the modeling job. The attribute information of the modeling data includes… the estimated usage amount." EX1024, [0102]. "During this modeling process, the recommended time for cartridge replacement is corrected on the basis of the actual amount of modeling material used in order to display the recommended time on the monitor screen 80." EX1024, [0141]-[0142], [0133]. A POSITA would have understood that Toshiki's modeling processing unit 402 controls operation of the three-dimensional printer during the fabrication process according to the amount of support material to be used (operational parameter) to fabricate an object with the three-dimensional printer by, e.g., monitoring the amount of support material used to update the amount of support material to be used (operational parameter) and notifying the operator to replace the cartridge during the fabrication process. EX1003, ¶114.

For the reasons discussed above in Section III.C.2, a POSITA would been motivated to implement Loughran's system based on Toshiki's suggestion such that when the amount of support material to be used in the modeling process (operational parameter specifying a support structure requirement) is suitable for the printer to complete the print job, the SFF mechanism 502 controls operation of the SFF system 104 (printer) during fabrication of the object according to the amount of support material to be used in the modeling process (operational parameter) by, e.g., monitoring the amount of support material used (operational parameter) and notifying the operator to replace the cartridge during the fabrication process. EX1003, ¶115.

(a) Claim 2

Supra, element 1[a]. EX1003, ¶116.

(a) Claim 3

Supra, element 1[a]. EX1003, ¶117.

(a) Claim 4

Supra, element 1[a]. EX1003, ¶118.

(b) Claim 5

Loughran's SFF system 104 can include "a stereo lithography SFF system" where "plastic objects are built a layer at a time by tracing a laser beam on the surface of a vat of liquid photopolymer." EX1004, [0015]. Loughran's SFF system 104 can also include "a wide-area thermal inkjet or a single jet inkjet SFF system" where "a jet for each of a plastic build material and a wax-like support material is used." EX1004, [0016]. "The materials are held in a melted liquid state in reservoirs. The liquids are fed to individual jetting heads that squirt tiny droplets of the materials in the required pattern as they are moved to form a layer of the object." *Id.* Thus, Loughran discloses that the supply includes a liquid. EX1003, ¶119.

Loughran's SFF system 104 can also include "a fused deposition modeling SFF system" where "a plastic filament is unwound from a coil and supplies material to an extrusion nozzle." EX1004, [0017]. Thus, Loughran also discloses that the supply includes a filament. EX1003, ¶120.

(c) Claim 6

As discussed above in element 1[a], Loughran discloses a RFID tag. EX1004, [0021], [0033], [0047]. Loughran's RFID tag is either passive or active because RFID tags are of one of two types: passive or active. EX1007, 1; EX1003, ¶121.

(a) Claim 10

Supra, element 1[b]. EX1003, ¶122.

(a) Claim 11

As discussed above in element 1[b], Loughran discloses that "the information retrieved by the second SFF system 104 regarding the material 112 may include… parameters of the material 112, including, but not limited to, melting temperature, storage temperature, minimum feature size, horizontal and vertical shrinkage rates, material lifetime, inter-layer delay time, and amount of ultraviolet (UV) light required per layer, among other parameters." EX1004, [0024]. "These parameters may include the operating temperature that the second SFF system 104 needs to achieve to melt the material, the temperature that the second SFF system 104 needs to maintain to store the material, the length of time to wait after one layer of the material has been fabricated before processing the next layer, and so on." EX1004, [0025]. A POSITA would have understood that the "melting temperature" needed to "melt the material" is an operational parameter specifying an extruder temperature. EX1003, ¶123.

Toshiki also discloses that the "thickness of the modeling material layer for one slice is determined by the scanning speed of the modeling material nozzles 312 and 322 in the x direction and the amount of modeling material discharged per unit time." EX1024, [0085]. A POSITA would have understood that scanning speed, as taught by Toshiki, discloses or at least renders obvious a feed rate. EX1003, ¶124. A POSITA's understanding is corroborated by Evans, which discloses that "printer control applications have a way for moving each of the axes on a 3D printer, including settings for movement speed (feedrate)." EX1023, 51. Evans further discloses that "the speed at which the printer builds our objects" is "also called its print speed or feedrate." EX1023, 63.

(a) Claim 12

Element 12[p]

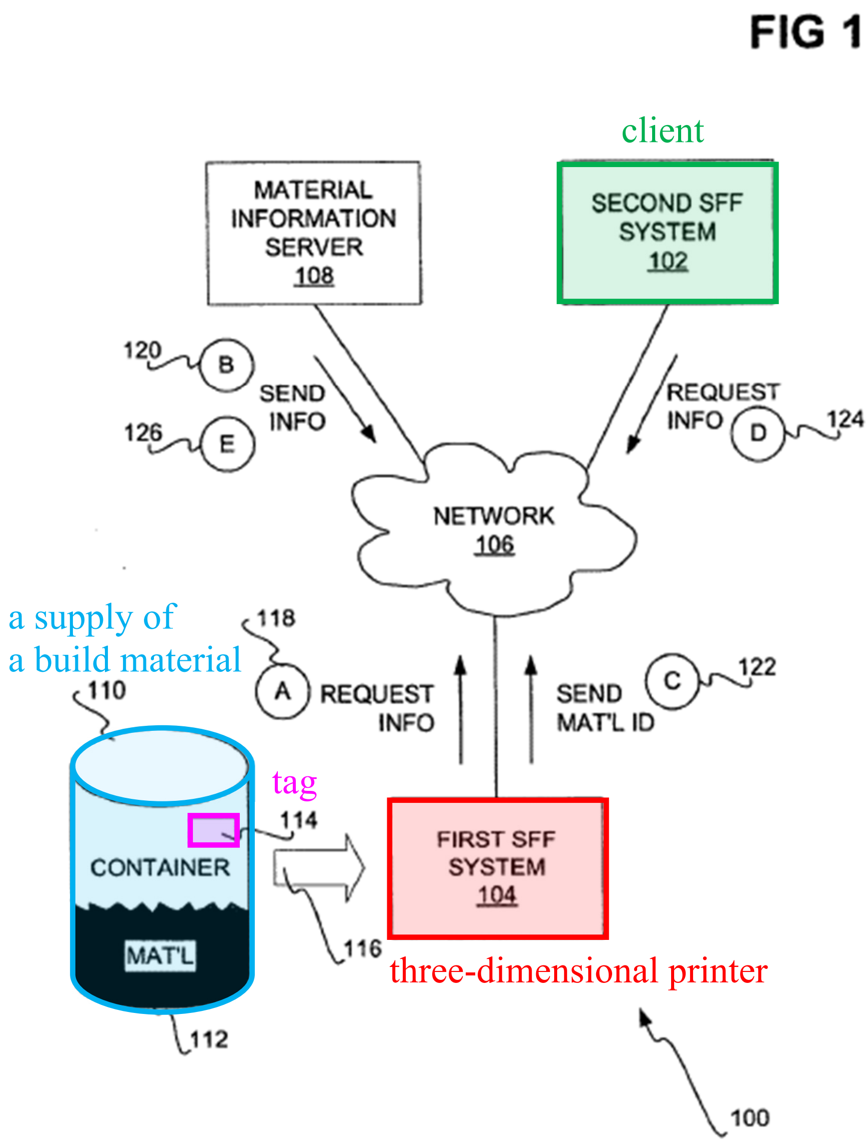
Supra, element 1[p] and 1[a]. EX1003, ¶125.

Element 12[a]

Supra, element 1[a]. EX1003, ¶126.

Element 12[b]

As discussed above in element 1[a], Loughran's FIG. 1 shows "a material container 110 containing a material 112 from which physical objects can be fabricated at the second SFF system 104 in accordance with SFF fabrication jobs generated at the [client] system 102 is introduced into the second SFF system 104, as indicated by the arrow 116":

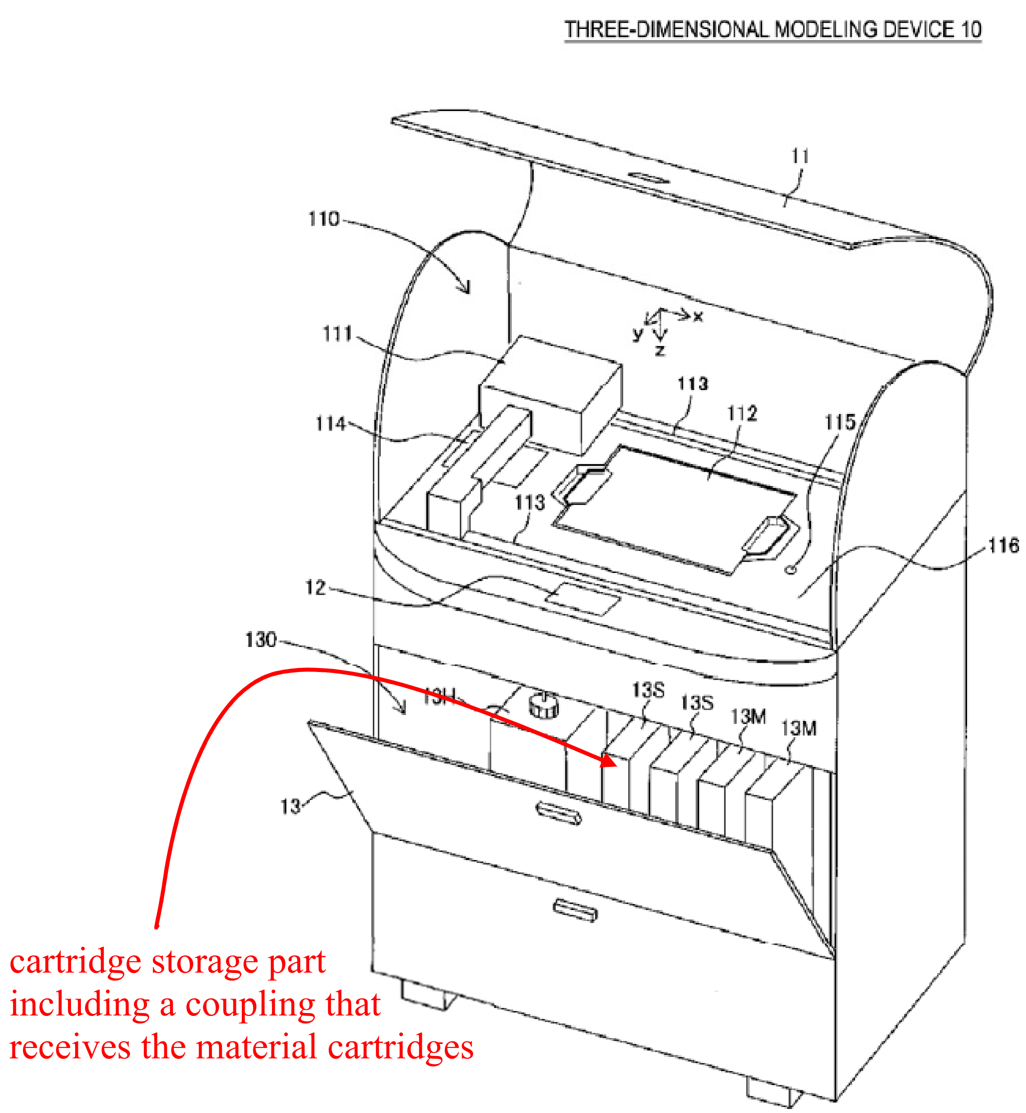


EX1004, FIG. 1, [0020]. The material container 110 containing material 112 is a supply of build material and is coupled to the SFF system 104 (three-dimensional printer) through introduction of the material container 110 into the SFF system 104. EX1003, ¶127. A POSITA would have understood that Loughran's SFF system 104 includes a coupling that receives the material container 110. *Id.*

Toshiki confirms that a three-dimensional modeling device such as

Loughran's SFF system 104 includes a coupling that receives a material container such as a material cartridge. EX1003, ¶128. For example, Toshiki discloses that a three-dimensional modeling device 10 includes "a cartridge storage part 130 that stores modeling material cartridges and the like":

FIG. 2



EX1024, FIG. 2, [0036]. "The cartridge storage part 130 stores two model material cartridges 13M" and "two support material cartridges 13S." EX1024, [0045], [0049]. "The model material cartridge 13M is a removable modeling material storage tank that contains the model material M prior to use. The support material cartridge 13S is a removable modeling material storage tank that contains the support material S prior to use. In other words, the model 15 material cartridge 13M and the support material cartridge 13S contain the modeling material prior to being discharged from the modeling material nozzles 312 and 322 of the head unit 111." EX1024, [0047]. A POSITA would have understood that the cartridge storage part 130 includes a coupling that receives the material cartridges so that the cartridges can be stored in the cartridge storage part and materials from the cartridges can be provided to the nozzles. EX1003, ¶128.

Element 12[c]

Supra, element 1[a]. EX1003, ¶129.

Element 12[d]

Toshiki discloses a "modeling estimation unit 204" that calculates "an estimated amount of modeling material to be used in the modeling process 223, on the basis of the modeling data 221," and describes an implementation where "the modeling estimation unit 204 may be provided in the three-dimensional modeling device 10, and the three-dimensional modeling device 10 may calculate… the estimated usage amount on the basis of the modeling data 221 received from the modeling requester terminal 20." EX1024, [0095]; *see also supra*, element 1[b]. As described above in element 1[c], Toshiki's "tank replacement determining unit 406" then compares "the current remaining amount of the model material M and the support material S with the cumulative amount of the modeling material to be used in model processing" as determined by the modeling estimation unit 204. EX1024, [0110], [0139], [0015], [0017]. A POSITA would have understood that the modeling estimation unit 204 and the tank replacement determining unit 406 are functional units executed by a processor. EX1003, ¶130; EX1001, 4:1-21 ("All such computing devices and environments are intended to fall within the meaning of the term 'controller' or 'processor'.").

Element 12[e]

Supra, elements 1[a] and 1[d]. A POSITA would have understood that each of Loughran's SFF mechanism 502 and Toshiki's modeling processing unit 402 are functional units executed by a controller for the three-dimensional printer. EX1003, ¶131; EX1001, 4:1-21 ("All such computing devices and environments are intended to fall within the meaning of the term 'controller' or 'processor'.").

(a) Claim 13

Supra, elements 1[a] and 12[b]. EX1003, ¶132.

(b) Claim 14

Supra, element 1[a] and 12[b]. EX1003, ¶133.

(c) Claim 15

Supra, claim 5. EX1003, ¶134.

(a) Claim 17

Supra, elements 1[a], 1[b], 1[c], 12[d]. EX1003, ¶135. Further, Toshiki discloses that "the modeling estimation unit 204 may be provided in the three-dimensional modeling device 10, and the three-dimensional modeling device 10 may calculate… the estimated usage amount on the basis of the modeling data 221 received from the modeling requester terminal 20." EX1024, [0095].

(a) Claim 18

Supra, element 1[a]. EX1003, ¶136.

(b) Claim 19

Element 19[p]

Supra, element 1[p]. EX1003, ¶137.

Element 19[a]

Supra, element 1[a]. EX1003, ¶138.

Element 19[b]

Supra, element 1[b]. EX1003, ¶139.

Element 19[c]

Supra, elements 1[a] and 1[b]. EX1003, ¶140.

Element 19[d]

Supra, element 1[b]. EX1003, ¶141.

Element 19[e]

Supra, element 1[c]. EX1003, ¶142.

Element 19[f]

Supra, element 1[d]. EX1003, ¶143.

IV. DISCRETIONARY DENIAL IS NOT JUSTIFIED

A. The Petition's New Prior Art and Errors Made During Prosecution Warrant Institution—35 U.S.C. § 325(d)

This Petition does not present a situation where the same or substantially the same prior art or arguments were previously presented during prosecution. Regarding Part 1 of the *Advanced Bionics* framework, Grounds 1A-2 relies upon Dahlin, Menchik, Loughran, and Toshiki, yet none of these publications were actually addressed in any Office Action or remarks during prosecution. *Amazon.com, Inc. v. M2M Sols. LLC*, IPR2019-01205, Paper 14, 15 (PTAB Jan. 27, 2020) ("a reference that 'was neither applied against the claims nor discussed by the Examiner' does not weigh in favor of exercising the Board's discretion under § 325(d) to deny a petition"); *FuboTV Media Inc. v. Dish Technologies L.L.C.*, IPR2024-00918, Paper 14, 33 (PTAB Nov. 21, 2024) ("Because the Office's evaluation of [the reference] was minimal, we find that factor (c) weighs against exercising discretion to deny institution."); *Samsung Electronics Co., Ltd. v. Maxell, Ltd.*, IPR2024-00867, Paper 9, 17 (PTAB Nov. 7, 2024) (Given "the lack of evidence showing that Nozaki '269 was meaningfully addressed by the

Office, we are reluctant to exercise our discretion to deny institution."); *Cisco Systems, Inc. v. Portsmouth Network Corp.*, IPR2024-00505, Paper 7, 19 (PTAB Aug. 6, 2024) ("factor (c) does not favor denying the petition… under Section 325(d)" where "Examiner did not cite to Gai in any rejection and did not specifically address Gai in any correspondence, other than initialing it in an IDS."). And even if Part 2 of the *Advanced Bionics* framework is addressed, it is clear that there was a material error during examination because the Dahlin-Menchik and Dahlin-Menchik-Loughran combinations provided Elements 1[c], 1[d], 12[d], 12[e], 19[e], and 19[f], which the examiner mistakenly believed to be missing from the prior art. *Supra*, Section II.B; *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6, at 8 n.9 (PTAB "precedential" February 13, 2020) ("misapprehending or overlooking specific teachings of the relevant prior art where those teachings impact patentability of the challenged claims").

B. The *Fintiv* Factors Weigh in Favor of Institution—35 U.S.C. § 314(a)

The *Fintiv* precedent should not be followed here because it exceeds the Director's authority, is arbitrary and capricious, and was adopted without notice-and-comment rulemaking. Even if considered, the factors favor institution.

Factor 1 is neutral since there is no evidence that, if the action is maintained and a stay is requested, the court will deny a stay.

Factor 2 is neutral because the theoretical start of jury selection in June 2026 in EDTX (EX1020) is merely one of six different litigations scheduled to start jury selection in the same court on the same date, and none of those parties—not even PO here—has certainty on which five litigations will be delayed/rescheduled. EX1025. Further, specific to this case, the theoretical start of jury selection in EDTX is not set in stone because there is a pending motion to dismiss the EDTX litigation in favor of litigation in another district (WDTX; a declaratory judgement action involving the same patent) where the jury trial is unscheduled but is statistically estimated to occur in mid-2027. EX1021. In reality, the jury trial in EDTX (if any) would not conclude until "at or around the projected deadline for the Final Written Decision." *Canadian Solar Inc. v. Maxeon Solar Pte. Ltd*., IPR2024-01194, Paper 12, 29-30 (PTAB January 24, 2025). Finally, Petitioner's diligence in preparing this petition in less than six months from service of the EDTX complaint also weighs against discretionary denial, especially in light of the stipulation (see Factor 4) that avoids overlap with obviousness grounds (if any) at the theoretical EDTX trial. *Canadian Solar*, 32 ("does mitigate, at least to some extent, concerns").

Factor 3 favors institution because there has been little investment by the court and the Markman hearing is scheduled for December 3, 2025, well after institution. See EX1020.

Factor 4 favors institution as Petitioner has made a stipulation not to pursue the IPR grounds in District Court. See EX1019.

Factor 5 is neutral. Although the parties in the parallel litigation are the same, there is no indication that the parallel litigation will reach a jury trial before the conclusion of this IPR.

And finally, Petitioner's Motion to Dismiss further favors institution under ***Factor 6*** because, if granted, there will be no potential overlap of issues between the IPR and parallel District Court action.

V. PAYMENT OF FEES – 37 C.F.R. §42.103

Petitioner authorizes the Patent and Trademark Office to charge Deposit Account No. 06-1050.

VI. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

In addition to Petitioner, Bambulab Limited, Shanghai Lunkuo Technology Co. Ltd., Tuozhu Technology Limited, and Bambulab USA Inc. are listed as potential real parties-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates, or other petitions for IPR of the '464 patent. The '464 patent was asserted in

Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd. et al., EDTX-2-24-cv-00645 (complaint service date: September 11, 2024). That case has been consolidated with EDTX-2:24-CV-00644, which involves the same plaintiff and defendants. Additionally, the '464 patent is the subject of a declaratory judgement action (for non-infringement) in *BambuLab USA, Inc. et al. v. Stratasys, Inc.*, WDTX-1-24-cv-01511 (filed on December 9, 2024). The parties are also involved in concurrent case nos. IPR2025-00257, IPR2025-00311, IPR2025-00321, and IPR2025-00354, IPR2025-00531, and IPR2025-00532.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

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D. Service Information

Please address all correspondence and service to the address listed above. Petitioner consents to electronic service by email at IPR56224-0011IP1@fr.com (referencing No. 56224-0011IP1).

Respectfully submitted,

Dated: February 6, 2025

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,690 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: February 6, 2025

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on February 6, 2025, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided via Express Mail, to the Patent Owner by serving the correspondence address of record as follows:

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