UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SHENZHEN TUOZHU TECHNOLOGY CO., LTD.,

Petitioner

v.

STRATASYS, INC.

Patent Owner.

PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 8,562,324

Case No. IPR2025-00311

PATENT OWNER'S RESPONSE

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Exhibit List

Exhibit No.	Description
2001	Docket Navigator – Judge Rodney Gilstrap Motion Success for Stay Pending IPR and Time to Milestones
2002	United States District Courts — Judicial Caseload Profiles for Eastern District of Texas (Sept. 30, 2024 and Dec. 31, 2024), available at https://www.uscourts.gov/data-news/reports/statistical-reports/federal-court-management-statistics
2003	Minute Entry for proceedings held before District Judge Gilstrap on Nov. 7, 2024, *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd.*, No. 2:24-cv-00644-JRG (E.D. Tex. Nov. 14, 2024)
2004	Discovery Order, *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd.*, No. 2:24-cv-00644-JRG, Dkt No. 35 (E.D. Tex. Dec. 2, 2024)
2005	Protective Order, *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd.*, No. 2:24-cv-00644-JRG, Dkt No. 36 (E.D. Tex. Dec. 3, 2024)
2006	e-Discovery Order, *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd.*, No. 2:24-cv-00644-JRG, Dkt No. 41 (E.D. Tex. Dec. 19, 2024)
2007	Invalidity and Ineligibility Contentions, *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd.*, No. 2:24-cv-00644-JRG, (E.D. Tex. Jan. 30, 2025)
2008	Transcript of Hearing on the Nomination of Howard Lutnick, of New York, to be Secretary of Commerce (Jan. 29, 2025)
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2010	Transcript of Deposition of Dr. Andrew Wolfe
2011	Abdul-Ameer, H. et al., Towards Computer Vision Feedback for Enhanced CNC Machining, IEEE (2011)
2012	U.S. Patent No. 7,168,935 to Taminger et al
2013	Uriarte, O., What Type of CNC Coolant Should I Use? (Oct. 2022), https://web.archive.org/web/20221020050138/https://www.cncmasters.com/cool-down-with-the-right-coolant/

I. INTRODUCTION

Pursuant to 35 U.S.C. § 313 and 37 C.F.R. § 42.107, Stratasys, Inc. ("Stratasys" or "Patent Owner") hereby submits this Response to the Petition for *inter partes* review ("Petition" or "Pet.") filed by Shenzhen Tuozhu Technology Co., Ltd. ("Petitioner"), challenging claims 1, 3-11, and 17-22 ("challenged claims") of U.S. Patent No. 8,562,324 ("the '324 Patent") (EX1001).

Petitioner alleges that the challenged claims are invalid based on 14 different grounds (1A through 2G). Petitioner argues that independent claims 1 and 19 are obvious over U.S. Patent No. 6,580,959 ("Mazumder") (EX1004) in view of U.S. Patent Publication No. 2010/0063615 ("Mori") (EX1005) in Ground 1A and over U.S. Patent Publication No. 2006/0054039 ("Kritchman") (EX1015) in view of Tay (EX1013) and Henke (EX1014) in Ground 2A.

Petitioner has failed to meet its burden of showing that it would prevail with respect to any of the challenged claims. The challenged claims and the '324 Patent are directed to solutions that include a user interface that presents both an image of a build volume from a video camera and a two-dimensional projection of the three-dimensional model that is fabricated as an object within the build volume of a three-dimensional printer, in which the projection is from the same point of view of the video camera, which enables side-by-side comparison for monitoring. The primary references Mazumder in Grounds 1A-1G and Kritchman in Grounds 2A-

2G each fail to teach such a user interface. Further, the secondary references Mori in Grounds 1A-1G and Tay/Henke in Grounds 2A-2G fail to remedy this deficiency. Petitioner's assertions are driven by hindsight, a flawed understanding of the intrinsic record, and misinterpretation of the references themselves. In addition, two of the references Mori and Henke are not proper references for an obviousness analysis. Mori is not analogous art under Petitioner's theory that it is in the same field of invention as the '324 Patent, and Henke is not analogous art under any potential theory.

In summary, Petitioner has failed to carry its burden to show that the challenged claims are unpatentable under any of the asserted grounds.

II. THE '324 PATENT AND THE CHALLENGED CLAIMS

A. Summary of the '324 Patent (EX1001)

The '324 Patent "relates to three-dimensional fabrication using networked resources." EX1001 at 1:14-15. The patent explained that "a more recent trend has emerged toward low-cost three-dimensional prototyping devices suitable for hobbyists and home users. As these resources become more readily and widely available, a need has emerged for networking capabilities and network management for three-dimensional printers." *Id.* at 1:20-28.

Figure 3 of the '324 Patent shows a networked three-dimensional printing environment 300 that includes multiple 3-D printers 304 interconnected with multiple devices via a data network 302.

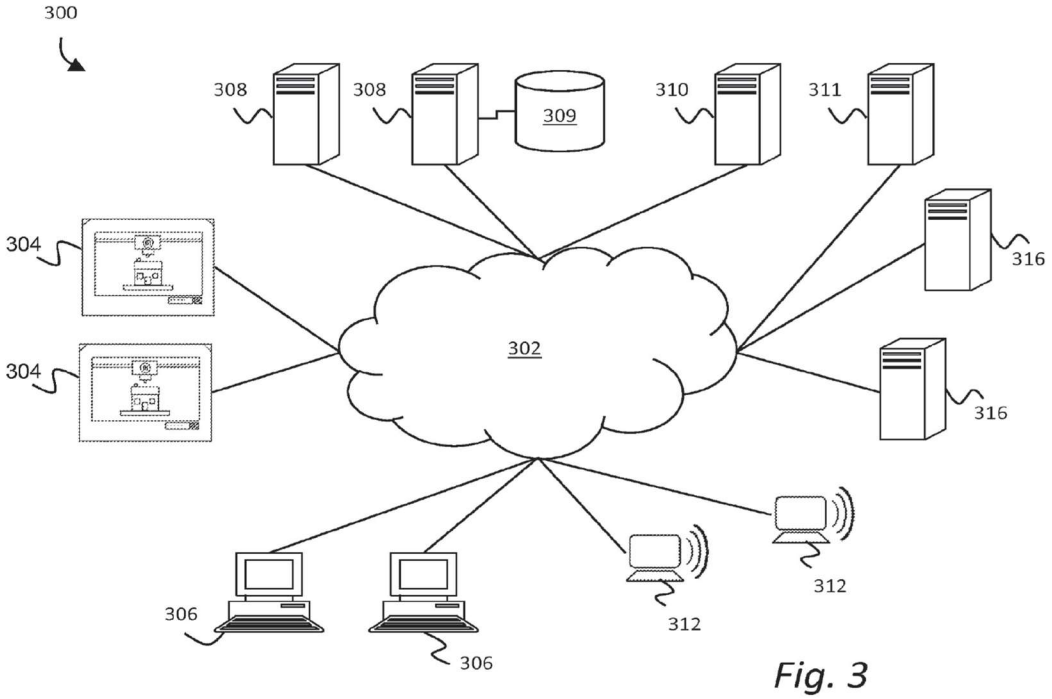


Fig. 3

Id. at 8:7-15, Fig. 3. The devices in Figure 3 include servers (e.g., print server 308, content sources 310, web server 311, other resources 316) and devices (e.g., client devices 306 and mobile devices 312). *Id.* at 8:12-15, 12:28-39, Fig. 3. The '324 Patent explains that client devices 306 are "operated by users to initiate and monitor print jobs at the three-dimensional printers 304." *Id.* at 8:49-51. Similarly, mobile devices 312 "may be operated by users for a variety of user-oriented functions such as . . . to submit objects for printing, to monitor a personally owned printer, and/or to monitor a pending print job." *Id.* at 12:47-51.

A diagram of a 3-D printer 100 is shown below in Figure 1 with a build platform 102, conveyor 104, extruder 106, positioning assembly 108, and controller 110 "that cooperate to fabricate an object 112 within a working volume 114." *Id.* at 2:17-21.

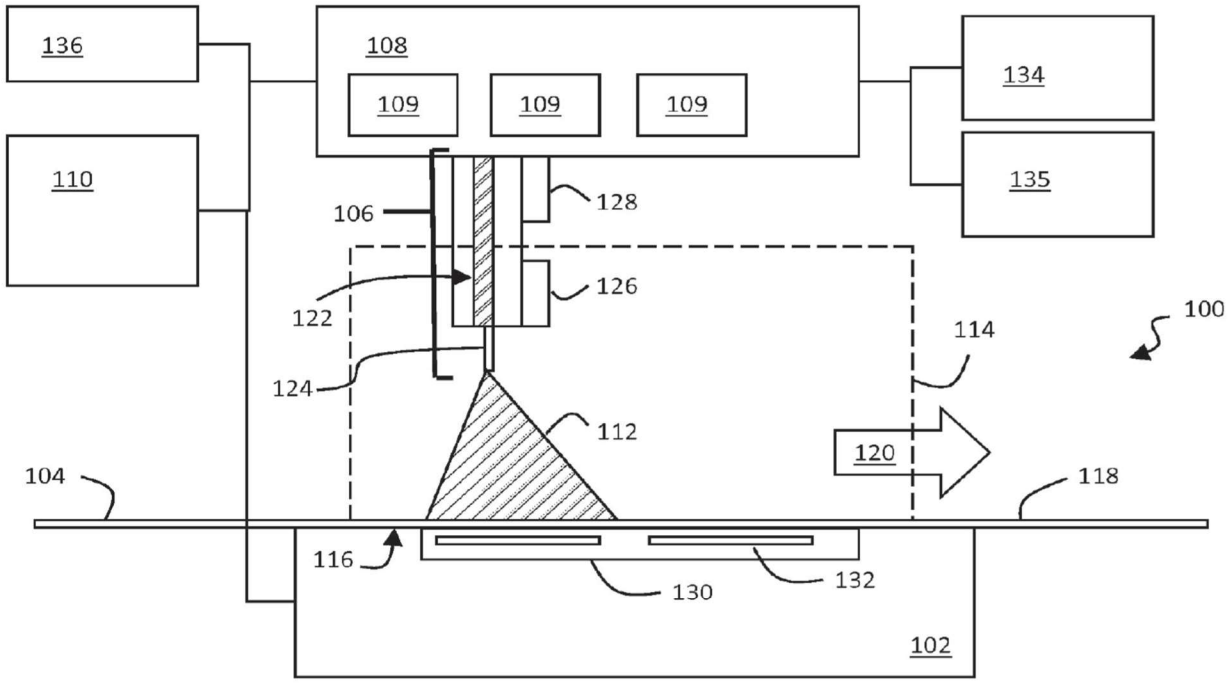


Fig. 1

Id. at Fig. 1. The printer includes one or more sensors 134, such as a video camera to "capture images" of the working volume 114 and object 112. *Id* at 6:21-24; *see also id.* at 18:33-36 (The "sensors may include a video camera directed toward a working volume of the three-dimensional printer."). The "video camera may provide a remote video feed through the network interface 136." *Id.* at 6:24-30; *see also id.*

at 6:30-33. This enables "video monitoring" by a user of the printer. *Id.* at 14:63-15:5.

To operate the 3-D printer with a video camera, the '324 Patent illustrates a flowchart in Figure 7 that "emphasizes incorporation of data from the video camera into operation and management of the three-dimensional printer." *Id.* at 24:24-28.

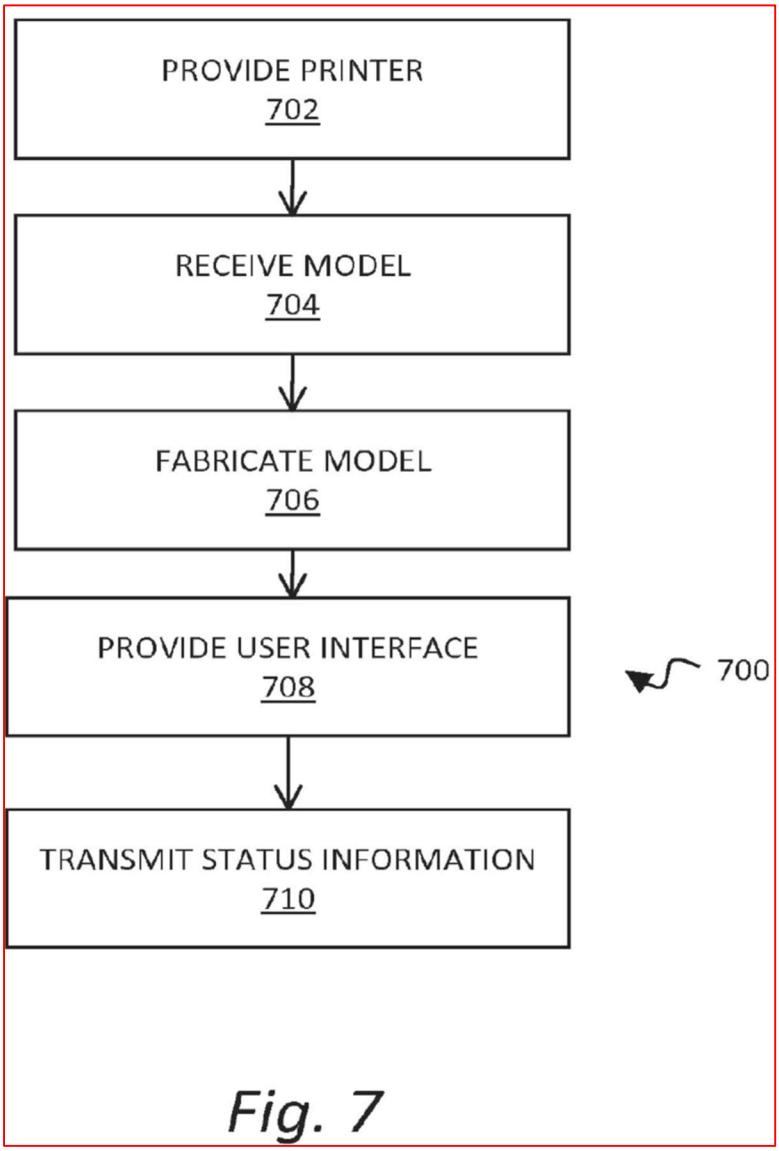
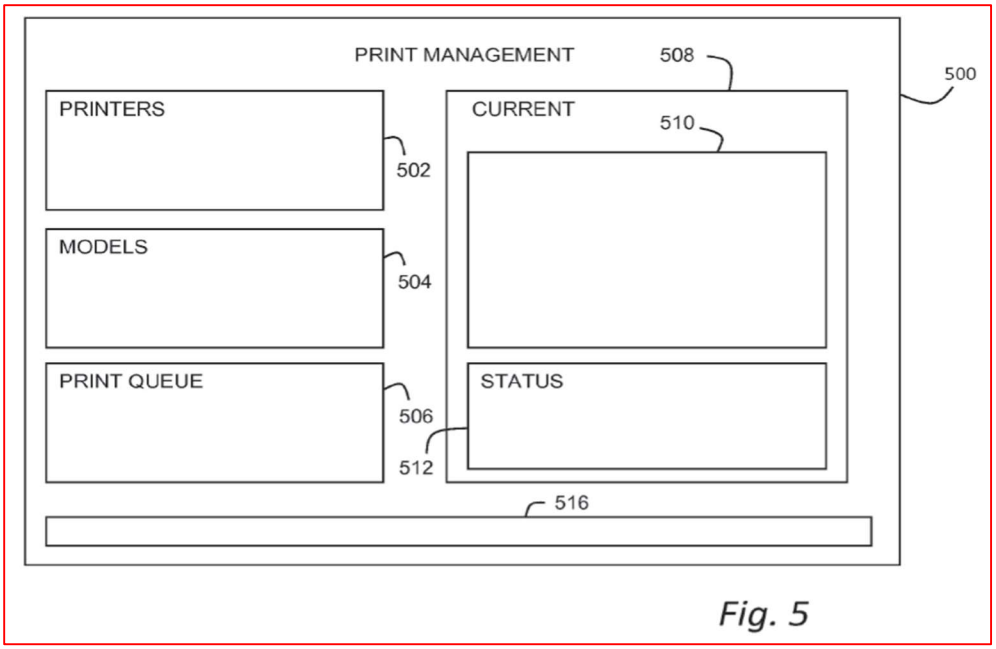


Fig. 7

Id. at Fig. 7. At step 702, "a video camera positioned to capture video of the build volume from a point of view, such as from above or in front a side of the build volume." *Id.* at 24:29-35. Steps 704 and 706 receive and fabricate the model. *See id.* at 24:36-46. The method 700 then proceeds to the next individual step (708) to "provide a user interface" that is for "a remote user accessing the device through the network interface." *Id.* at 24:47-52. In this individual step of providing a user interface, the "user interface presents an image of the build volume from the camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." *Id.* at 24:47-52. For example, the two-dimensional projection can be a "visualization of the model and its current state of completion." *Id.* at 24:58-61. The projection may be obtained from a "three-dimensional scanner or other data acquisition device" (*id.* at 24:61-64, 25:4-5) and may be "dynamically updated to correspond to a state of physical completion of the object" (*id.* at 24:64-25:3).

As the '324 Patent explains, the display of both the actual image and projection enables "comparing actual to expected two-dimensional" results, which enables action "without waiting for completion and physical inspection of the constructed object." *Id.* at 25:45-49. As shown below in Figure 5, "a user may visually monitor progress or status of a remote print job through the user interface 500." *Id.* at 22:41-60.



Id. at Fig. 5. As shown, user interface 500 includes four display areas (502, 504, 506, 508) and a menu bar (516). The first display area (502) "shows a list of available online three-dimensional printers or other fabrication resources." *Id.* at 21:40-42; *see also id.* at 21:42-45. In addition, the first display area (502) can "provide status information for each listed fabrication resource, such as information about availability, recent print activity, [and] a current queue of objects for printing at that resource." *Id.* at 21:45-49. The second display area (504) "shows a list of available models for fabrication by the fabrication resources." *Id.* at 21:54-56; *see also id.* at 21:56-60. The third display area (506) "shows a print queue." *Id.* at 22:11-12; *see also id.* at 22:12-16.

The fourth display area (508) includes a visualization area (510) and a status area (512). The visualization area (510) shows "a current tool path of the printer

that is executing the print job," "a simulated print object, such as a rendering of a three-dimensional model depicting a current state of the completion of an object being fabricated according to a print job," and "an image of a working volume of a three-dimensional printer or other fabrication resource captured during execution of the print job." *Id.*at 22:41-55. The '324 Patent explains that the visualization area 510 permits a user to "visually monitor progress or status of a remote print job through the user interface 500." *Id.*at 22:56-57. Further, the status area (512) "shows current status information (e.g., percentage completion, time until start, time until completion, and so forth) for the active resource." *Id.* at 22:57-60.

Numerous claims embody these solutions, including independent claims 1 and 19. For instance, claim 1 recites "a video camera positioned to capture video of the build volume from a point of view." *Id.* at 27:23-24. Similarly, claim 19 recites "a video camera positioned to capture video of the build volume from a point of view." *Id.* at 28:34-35. In addition, claim 1 recites a "processor further configured to provide a user interface to a remote user accessing the device through the network interface" and "to present in the user interface" both "an image of the build volume from the video camera *and* a two-dimensional projection of the three-dimensional model *from the point of view of the video camera*." *Id.* at 27-29-35. Similarly, claim 19 recites "a video camera positioned to capture video of the build volume from a point of view" (*id.* at 28:34-35) and "providing a user

interface to a remote user accessing the device through the network interface" in which "the user interface presents" both "an image of the build volume from the video camera *and* a two-dimensional projection of the three-dimensional model *from the point of view of the video camera*" (*id.* at 28:41-46).

As explained below, the asserted grounds fail to teach the elements of claim 1. Because claims 3-11, 17-18 depend from claim 1 and claims 20-22 depend from claim 19, the asserted grounds also fail to teach the elements of dependent claims 3-11, 17-18, and 20-22 for at least the same reasons.

Further, none of the asserted grounds teach claims 5, 6, and 8.

B. Summary of the Prosecution History of the '324 Patent (EX1002)

During prosecution, the applicant explained that unlike the cited art, "in order for a remote user to monitor progress of fabrication in a meaningful way," the user interface must both show an image of an object being manufactured from a video camera and render a three-dimensional model of the object from the same point of view. May 22, 2013 Amendment and Reply to Office Action at p. 7 (EX1002 at 160). By the user interface presenting both the image and projection, the applicant explained that it "advantageously permit[s] side-by-side comparison by a remote user of the model and the resulting object." *Id.* Further, this feature "is expressly claimed as a processor configured to 'present in the user interface an image of the build volume from the camera *and a two-dimensional projection of*

the three-dimensional model from the point of view of the video camera.'" *Id.* (emphasis in original).

On this basis, the applicant argued that the cited art (U.S. Pat. No. 7,168,935 to *Taminger*) did not disclose the claimed user interface. *See id.* ("*Taminger* does not teach or suggest any processor that provides an interface to a remote user that includes both an image from a camera *and* a two-dimensional rendering of a model from the point of view of the camera."). The applicant recognized that "*Taminger* suggests remote control and monitoring of a three-dimensional fabrication process" and that it discloses using a camera and user interface. *See id.* at 161 (citing *Taminger* (EX2012), 11:25-27, 11:37-41, 12:3-7). However, the applicant argued that nothing "specifically leads to the applicant's claimed user interface, which provides both video and model views from the same point of view in order to permit *side-by-side comparison* of model and results by a remote user." *Id.* at 161 (emphasis added). Thus, the applicant concluded that the *Taminger* "cannot anticipate the invention of claim 1 because [it] does not teach a processor configured to provide a user interface [to a remote user] that includes an image of a build volume from a video camera *and* a two-dimensional projection of a three-dimensional model from the point of view of the video camera." *Id.*

The examiner agreed with the applicant, noting, in the notice of allowance, that the cited art failed to teach "*presenting the user interface an image of the build*

volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." Aug. 5, 2013 Notice of Allowance at p. 2 (EX1002 at 174) (emphasis in original). Not only did the examiner agree with the applicant, but the examiner also explicitly referenced the applicant's argument leading to allowance. *See Id.* (citing to "applicant's argument on page 7, lines 7-25); *see also id.* at 160 (page 7 of applicant's argument). In particular, applicant argued in the lines cited by the examiner that the feature of enabling a remote user to monitor progress with a user interface that permits side-by-side comparison of the model and resulting object was "expressly claimed as a processor configured to 'present in the user interface an image of the build volume from the camera *and a two-dimensional projection of the three-dimensional model from the point of view of the video camera*.'" *Id.* at 160 (emphasis in original).

As explained below, the references asserted in the Petition suffer from the same deficiencies as the art cited during prosecution and in the asserted grounds do not teach all elements of independent claims 1 and 19 of the '324 Patent.

III. LEVEL OF ORDINARY SKILL

For the purpose of this Response, a personal of ordinary skill in the art (a "POSITA") in relation to the subject matter of the '324 Patent would have had a bachelor's degree in Mechanical Engineering, Computer Engineering, Electrical

Engineering, Materials Science, or a comparable field and at least two years of experience related to 3D printing, with additional experience potentially being a substitute for a formal degree or training (and vice versa). EX2009, ¶¶21-26.

As explained below, the Petition has failed to show that the claims of the '324 Patent are unpatentable irrespective of the level of skill of a skilled artisan. *Id.*

IV. CLAIM CONSTRUCTION

For the purposes of this response, Patent Owner submits that the Board does not need to construe any claim terms to conclude that the Petition is deficient and thus a finding of unpatentability of any claim is not warranted. *See Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (claims "construed 'to the extent necessary to resolve the controversy'").

To the extent Petitioner argues that the claims of the '324 Patent permit the user interface to present the image from the video camera followed or preceded by presenting a projection at different times, this understanding is contrary to the plain and ordinary meaning of the claims. In the Institution Decision, the Board preliminarily concluded that the claims do not require the image and projection "be presented simultaneously, only that they both be presented." Paper 9 at 24-25. However, this interpretation is not consistent with the claims, specification, and prosecution history, which as discussed below, show that the claims require a user

interface that presents both the image and projection together from the point of view of the video camera at the same time.

Claim 19, for instance, has a single step—"providing a user interface to a remote user accessing the device through the network interface"— in which the provided user interface presents both "an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." EX1001, at 28:41-46. Claim 1 recites a similar requirement for a processor configured to "provide a user interface to a remote user accessing the device through the network interface." *Id.* at 27:30-32. Nothing in the claims suggests that the user interface can present an image followed or preceded by presenting a projection. *See id.* 27:23-24, 27:33-35, 28:34-35, 28:44-46. As explained below, both the specification and file history explain that a user interface for a remote user that presents the image and projection from the same point of view at the same time allows a remote user to monitor the fabrication process with a side-by-side comparison of the image and projection.

The specification of the '324 Patent repeatedly explains that a remote user must be able to manage the use of a three-dimensional printer. The Abstract, for example, says that servers "can provide a single point of access for remote users . . . to manage use of distributed fabrication resources." *Id.* at Abstract; *see also id.* at 1:36-38. The background of the '324 Patent explains that there is a need for

"networking management for three-dimensional printers." *Id.* at 1:25-28. The '324 Patent also explains such management can be performed using remote client devices (306 in Figure 3) that are "operated by users to initiate and monitor print jobs at the three-dimensional printers 304." *Id.* at 8:49-51.

Consistent with these disclosures, the '324 Patent shows a flowchart in Figure 7 for a method (700) for operating a three-dimensional printer with a video camera and a network interface:

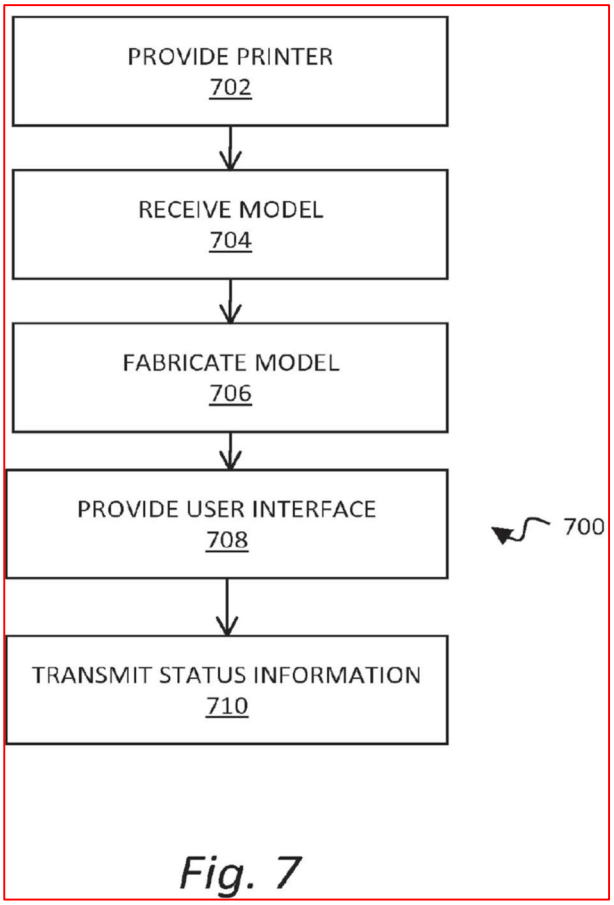


Fig. 7

Id. at Fig. 7. As shown, the method (700) includes a single step (708) that "provide[s] a user interface" for "remote user" access to the printer in which "user

interface presents an image of the build volume from the camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." *Id.* at Fig. 7, 24:47-52. Nothing in the patent's disclosure suggests that the user interface can present an image followed or preceded by presenting a two-dimensional projection at different times.

As shown below in Figure 5, "a user may visually monitor progress or status of a remote print job through the user interface 500." *Id.* at 22:41-60.

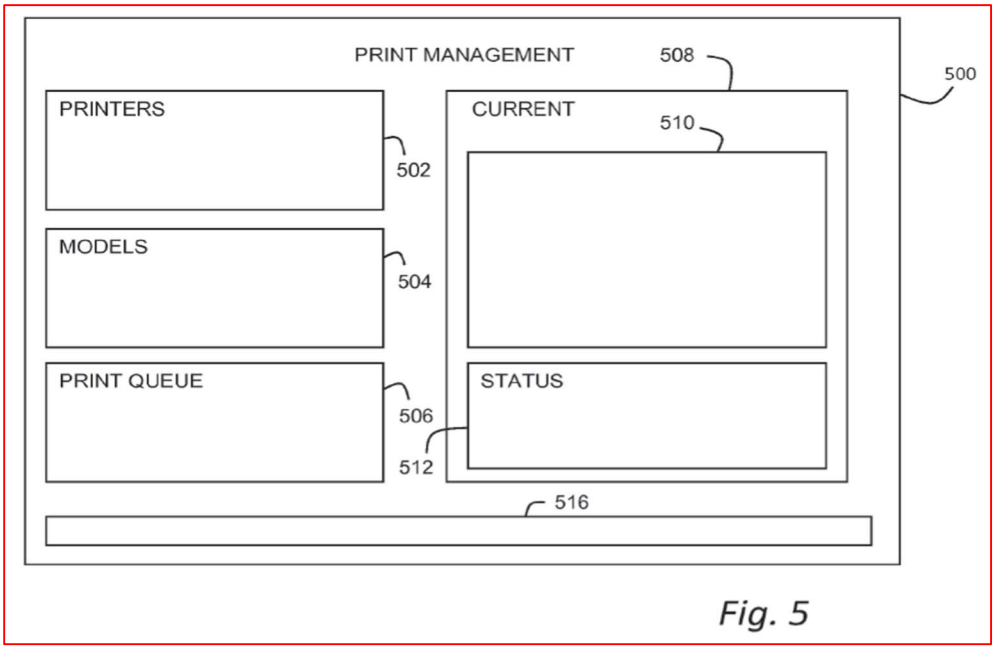


Fig. 5

Id. at Fig. 5. The visualization area 510 displays a visual representation of the print job, such as "a current tool path of the printer that is executing the print job," "also or instead [] a simulated print object," and "also or instead [] an image of a working volume." *See id.* at 22:41-55. But nowhere does the description of Figure 5 suggest that the user interface can present an image followed or preceded by presenting a

two-dimensional projection in at different times. Indeed, as discussed above, the claims require presenting both an image and a projection from the same point of view at the same time, which is consistent with the method 700 disclosed in the specification of the '324 Patent. *See id.* 28:41-46, 27:30-32, 24:47-52, Fig. 7.

The specification of the '324 Patent also explains the purpose of a user interface for a remote user presenting both the actual image and projection from the same point of view at the same time. In particular, doing so enables "comparing actual to expected two-dimensional" results, which enables taking action on the fabrication process "without waiting for completion and physical inspection of the constructed object." *Id.* at 25:45-49; *see also id.* at 22:35-38 (further providing the option for automated, computer-based monitoring by comparison of the two-dimensional projection with the image). Again, nothing suggests that the remote user can compare actual to expected two-dimensional results by the user interface presenting the actual results followed or preceded by presenting the expected results at different times.

Further, had the patentee wanted to describe a presentation at different times, it would have done so. Indeed, the specification of the '324 Patent shows that the patentee was more than aware of how to describe sequential operations. For example, the '324 Patent explains that certain three-dimensional printers can "include a tool or system to enable *multiple, sequential object prints* without

human supervision or intervention, such as the conveyor belt described above." *Id.* at 15:19-22 (emphasis added). As another example, a "print server 308 may also communicate periodically with three-dimensional printers 304 in order to obtain status information concerning, e.g., availability of printers and/or the status of particular print jobs, any of which *may be subsequently presented to a user* through the web server." *Id.* at 9:17-22; *see also id.* at 15:59-63 ("a user may limit the number of objects fabricated . . . *giving subsequent priority* to content from other sources"). Thus, the specification of the '324 Patent is consistent with the plain meaning of the claims, which require a user interface to present the image and projection at the same time.

Similar to the specification of the '324 Patent, the prosecution history confirms the plain meaning of the claims. During prosecution, the applicant recognized that the cited art (*Taminger*) suggests "remote control and monitoring of a three-dimensional fabrication process" and discloses the user of a camera and user interface. But nothing in *Taminger* "specifically leads to the applicant's claimed user interface, which provides both video and model views from the same point of view in order to permit *side-by-side comparison* of model and results by a remote user." May 22, 2013 Amendment and Reply to Office Action at p. 7 (EX1002 at 161) (emphasis added). Consistent with the applicant's arguments about *Taminger*, the applicant explained that unlike the reference, "in order for a

remote user to monitor progress of fabrication in a meaningful way," the user interface must both show an image of an object being manufactured from a video camera and render a three-dimensional model of the object from the same point of view. *Id.* at 160. By the user interface presenting both the image and projection, the applicant explained that it permits side-by-side comparison by a remote user monitoring progress of fabrication. *Id.* Further, the applicant explained that this feature "is expressly claimed as a processor configured to 'present in the user interface an image of the build volume from the camera *and a two-dimensional projection of the three-dimensional model from the point of view of the video camera*.'" *Id.* (emphasis in original). The examiner agreed with the applicant, noting in allowance that *Taminger* failed to teach the very same claim element that the applicant had argued was missing in the reference, and expressly citing the applicant's specific arguments that the user interface presents both an image and projection at the same time, which permits side-by-side comparison of the image and projection by a remote user. *See id.* at 174; *supra* Section II.B (Summary of the Prosecution History of the '324 Patent). Thus, the prosecution history confirms the plain and ordinary meaning of the claims, which requires a user interface that presents both an image and projection from the same point of view at the same time.

Accordingly, to the extent Petitioner argues that claims permit the user interface to present the image followed by presenting a projection at different times, such an argument is inconsistent with the plain and ordinary meaning of the claims. EX2009, ¶¶119-126. As discussed below, under the plain and ordinary meaning of the claims, Petitioner has failed to satisfy its burden to show that the independent claims are unpatentable under Grounds 1A or 2A.

V. APPLICABLE LEGAL STANDARDS

Each of Petitioner's grounds relies on obviousness under 35 U.S.C. § 103. A claim cannot be considered obvious if even one element of the claim is absent from the prior art. *See CFMT, Inc. v. YieldUp Int'l Corp.*, 349 F.3d 1333, 1342 (Fed. Cir. 2003) ("Obviousness requires a suggestion of all limitations in a claim.") (citing *In re Royka*, 490 F.2d 981, 985 (C.C.P.A. 1974)); *In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993) (reversing obviousness rejection as not all claim elements were taught or suggested); *Garmin Int'l, Inc. v. Patent of Cuozzo Speed Techs. LLC*, IPR2012-00001, Paper 15 at 15 (PTAB Jan. 9, 2013) (finding prior art did not disclose all claim limitations in obviousness challenge).

Obviousness is resolved based on several factual determinations including the scope and content of the prior art, any differences between the claimed subject matter and the prior art, and the level of ordinary skill in the art. *See Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). IPR petitions "must address the

Graham factors." *Eizo Corp. v. Barco N.V.*, IPR2014-00358, Paper 11 at 29-30 (PTAB July 23, 2014) (citing *Graham*, 383 U.S. at 17-18) (faulting petitioner for failing to identify differences between the claims and prior art and its conclusory assertions about the teachings of the prior art); *see also Moses Lake Indus., Inc. v. Enthone, Inc.*, IPR2014-00243, Paper 6 at 18 (PTAB June 18, 2014); *Moses Lake Indus., Inc. v. Enthone, Inc.*, IPR2014-00246, Paper 6 at 17 (PTAB June 18, 2014); *eBay, Inc. v. Paid, Inc.*, CBM2014-00125, Paper 15 at 21 (PTAB Sept. 30, 2014).

The conclusion of obviousness based on the combination of references must be supported by an explicit analysis of a reason to combine such references. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). Mere conclusory statements are insufficient. Instead, "there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); *see also LG Elecs., Inc. v. Cellular Commc'ns Equip. LLC*, IPR2016-00197, Paper 7 at 7-11 (PTAB Apr. 29, 2016) (petition lacked sufficient articulated reasons with rational underpinnings for modifying references to achieve specific elements of the claims).

VI. THE PETITION DOES NOT SHOW THAT THE CLAIMS 1, 3, 5-7, 9-10, AND 19-22 ARE UNPATENTABLE UNDER GROUND 1A

A. Overview of Mazumder (EX1004)

Mazumder discloses a system and method for remote direct material deposition fabrication. EX1004, Title. Mazumder's "fabrication process is

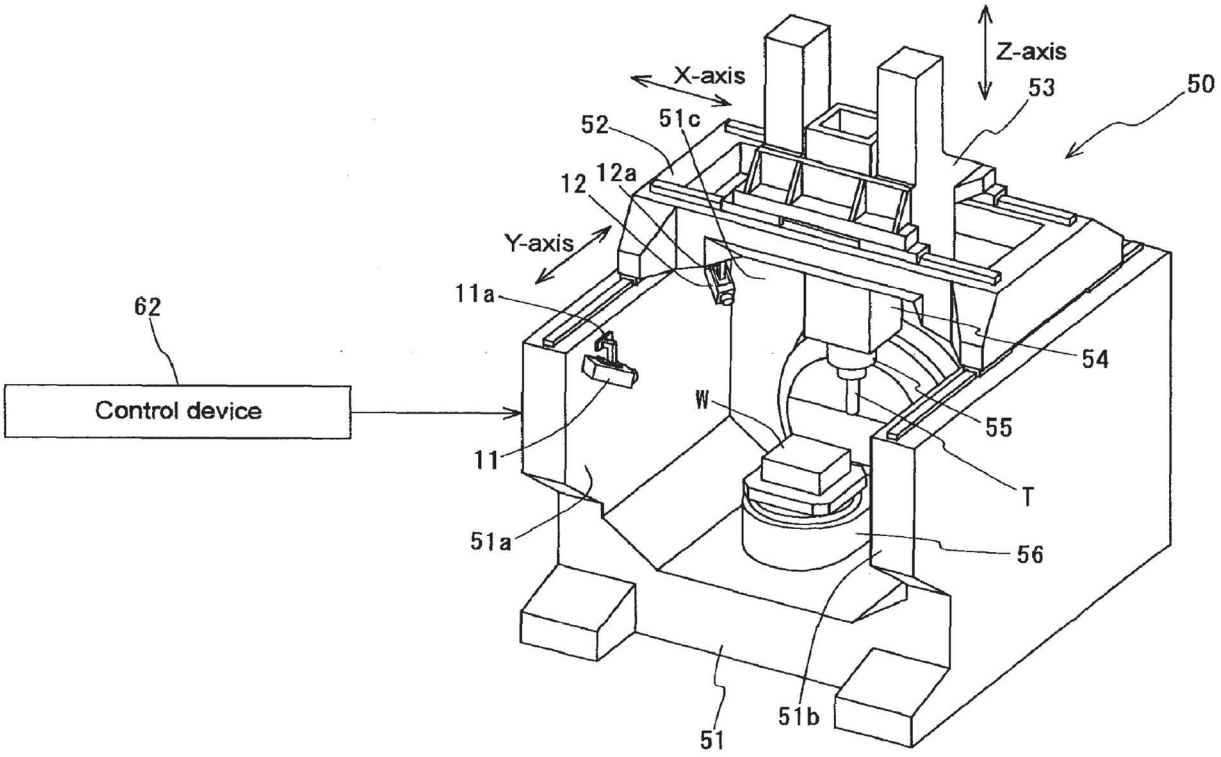
recorded by video or television camera and the shown in real-time on a screen display connected to the remote computer." *Id.* at Abstract. The "video or TV camera 65 records the laser-aided DMD process and transmits the images to the local computer 70" which then sends the images "to the remote computer 95 to be displayed preferably on a TV screen or shown on the remote computer monitor as streaming video." *Id.* at 6:36-43. The remote computer has "two monitors, one with a graphical user interface and the other for image and video observation of the laser-aided direct material deposition process." EX1004, 2:27-33.

B. Overview of Mori (EX1005)

Mori discloses a machine tool with a machining status monitoring apparatus. EX1005 at Title. The apparatus has multiple actual CCD cameras for imaging the machine tool and virtual CCD cameras for generating virtual images of the entire machining tool. *Id.* at Abstract.

Figure 2 shows a machining status monitoring apparatus.

Fig. 2



Id. at Fig. 2, ¶[0031]. The machining tool 50 includes a machining status monitoring apparatus called a machining center. *Id.* at ¶[0043]. As shown, the machining tool (50) includes a tool (T) to machine a workpiece (W) on a table (56). *Id.* at Fig. 2.

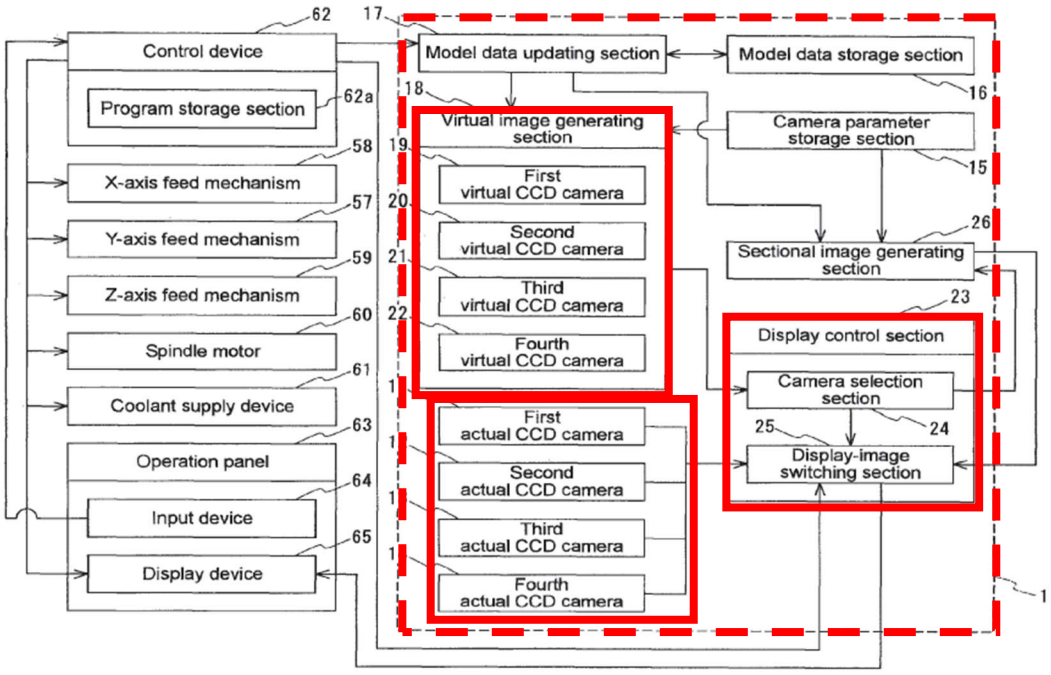
Mori discloses two embodiments for machine status monitoring. Mori discloses its first embodiment in its Abstract and Summary. *See* EX2009, ¶¶83-92. Mori uses virtual image data to select virtual cameras when the tool is not hidden from a workpiece to display actual image data from actual cameras corresponding to the selected virtual cameras. *See* EX1005, Abstract; *see also id.* at [0004]-[0029] (Summary of Invention). Mori does not disclose displaying virtual image data in

this embodiment. *See id.* Instead, Mori explains that if the "tool is hidden by the workpiece in all of the actual" images and "the operator cannot monitor the machining status of a workpiece," Mori's solution will generate and display sectional image data rather than actual image data. *Id.* at [0024]; *see also id.* at [0023], [0025]-[0028]. Thus, Mori describes always displaying actual image data unless the tool is hidden, in which case it displays sectional image data.

The second embodiment disclosed in Mori's detailed description adds the ability to also switch to displaying virtual image data when coolant is being supplied. *See, e.g.*, *id.* at [0087]. Notably, both embodiments of Mori provide a solution that switches between image data types (actual or sectional in embodiment one, and actual, virtual, or sectional in embodiment two) for display. As discussed below, Mori does not teach a display that provides one type of image and another type of image at the same time.

With respect to Mori's second embodiment, Figure 1 of Mori provides a block diagram of a machining status monitoring apparatus (1).

Fig. 1



Id. at Fig. 1, ¶[0030]. Mori shows four actual cameras (11-14) and four virtual cameras (19-22 in virtual image generating section 18) that each correspond to one of the actual cameras arranged at the same position. *Id.* at Fig. 1, [0062]. Mori also discloses several sections: camera parameter storage section (15), model data storage and updating sections (16 and 17), virtual image generating section (18), display control section (23), and sectional image generating section (26). *Id.*

The camera parameter storage section (15) stores parameters of each actual camera, such as "a principal point coordinate, a scale factor, skewness of the two image axes and the like." *Id.* at [0051].

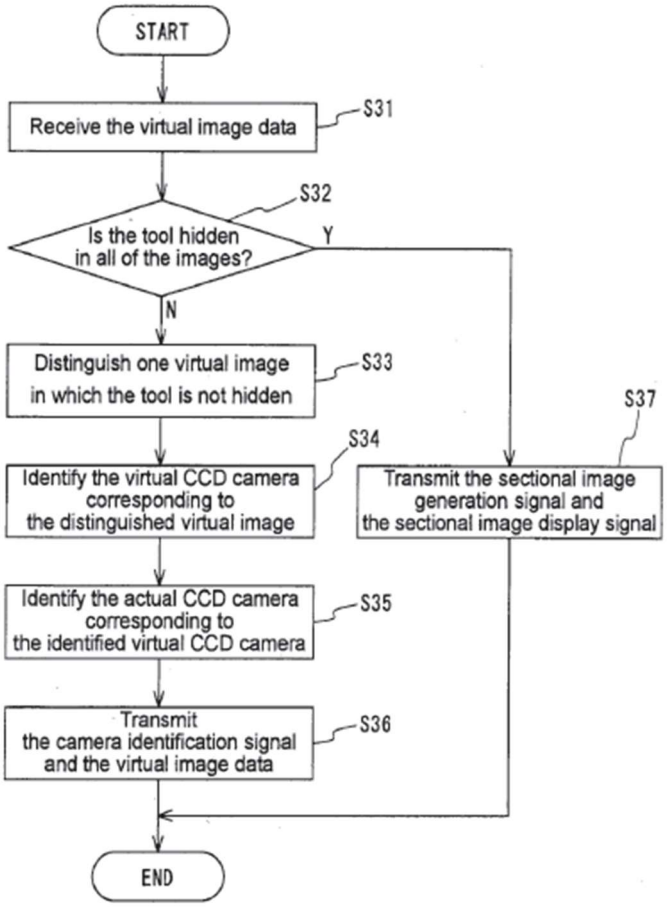
The model data updating section (17) "updates the model data of the entire machine tool 50 stored in the model data storage section 16" including data for the

bed (51), first saddle (52), second saddle (53), spindle head (54), spindle (55), table (56), tool (T), and workpiece (W). *Id.* at [0052]-[0054]; *see also id.* at Fig. 5, [0054]-[0058] (describing Fig. 5).

The virtual image generating section (18) generates virtual image data of the tool, workpiece, and part of table 56 based on parameters in camera parameter storage section (15) and model data updating section (17). *Id.* at [0059]; *see also id.* at Figs 6.-7, [0060]-[0064] (discussing Figs. 6-7), [0014], [0018]-[0019] (generating virtual image data).

The display control section (23) includes a camera selection section (24) and a display-image switching section (25). *Id.* at Fig. 1. The camera selection section (24) selects one actual and one corresponding virtual camera. *Id.* at [0065]. As Mori explains in its Summary, it selects "at least one" virtual camera image where "the distal end of the tool is not hidden" and displays the actual image "corresponding to the selected" virtual image. *Id.* at [0020]-[0021]. As shown below, Figure 8 of Mori is a flow chart for the operation of camera selection section (24).

Fig. 8

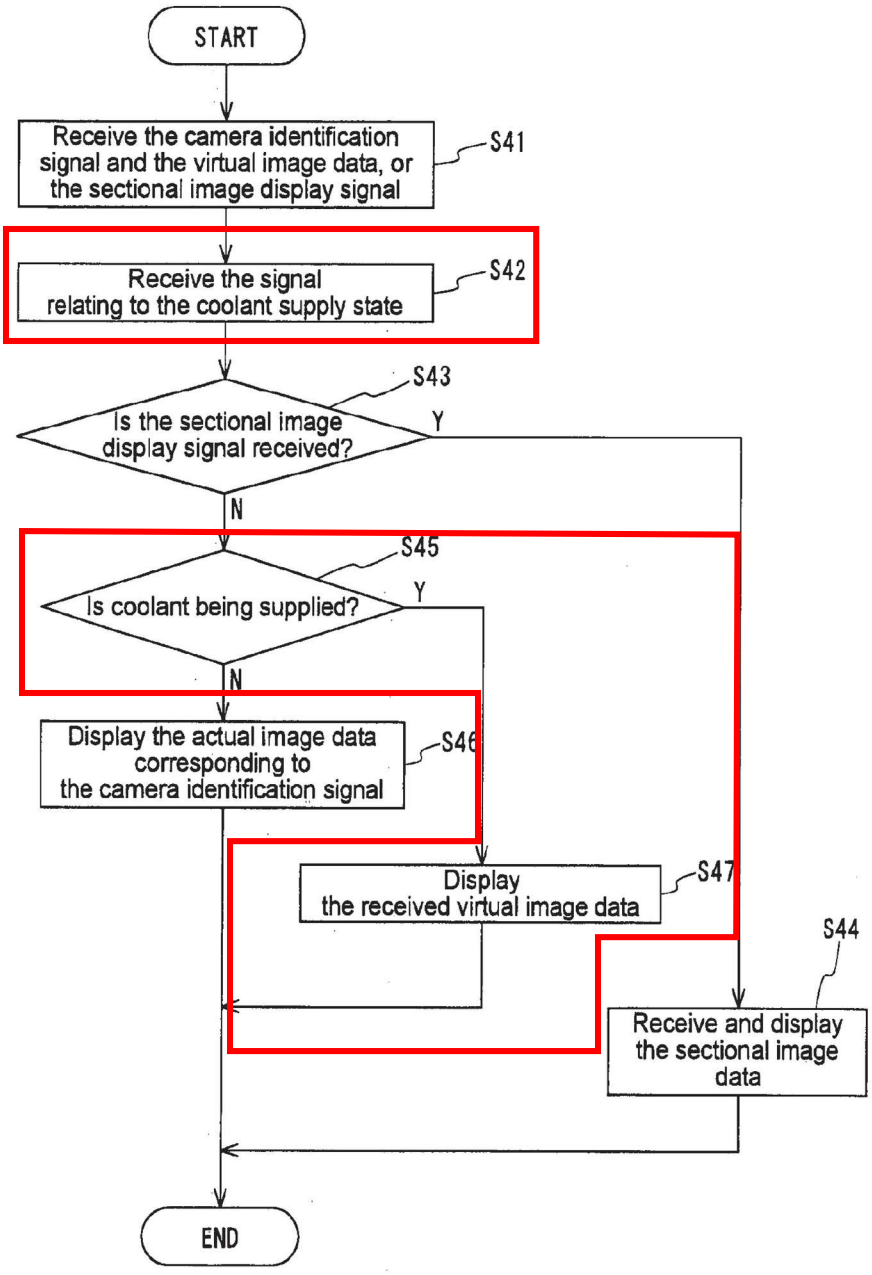


Id. at Fig. 8, [0066]-[0069] (describing Fig. 8), [0015]. More specifically, section 24 receives virtual image data (S31) and checks whether the tool is hidden in all virtual images (S32). If the tool is hidden, section 24 transmits a sectional image generation signal and sectional image display signal (S37). Otherwise, section 24 distinguishes at least one virtual image in which the tool is not hidden (S33), identifies the corresponding virtual camera (S34), identifies the actual camera corresponding to the identified virtual camera (S35), and transmits a camera identification signal with the virtual image data (S36). *Id.* Thus, at least one of the virtual cameras and

corresponding actual cameras is selected and, therefore, "actual images" where "the tool is not hidden can be always displayed." *Id.* at [0022]; *see also id.* at [0020].

The display-image switching section (25) switches the image displayed between the actual image data from actual cameras (11-14), virtual image data from camera selection section (24), or sectional image data transmitted from the sectional image generating section (26). *Id.* at Fig. 1, [0070]. As shown below, Figure 9 of Mori is a flowchart of the display-image switching section (25).

Fig. 9



Id. at Fig. 9 (annotated), [0071]-[0073]. More specifically, section 25 receives the sectional image display signal, or the camera identification signal and virtual image data, from the camera selection section (24) (S41) and receives a signal for

coolant supply state (S42). *Id.* If the sectional display signal is received (S43), section 25 receives and displays sectional image data (S44). *Id.* Otherwise if coolant is being supplied (S45), section 25 displays the received virtual image data (S47). *Id.* Otherwise, section 25 displays the actual image data corresponding to the camera identification signal from the camera selection section (S46). *Id.*

As shown by the annotations to Figure 9 above, the portions outlined in red (steps S42, S45, S47) represent the additions in Mori's second embodiment to switch to displaying the virtual image data if coolant is supplied.

The sectional image generating section (26) generates sectional image data if its receives the sectional image generation signal from the camera selection section (24). *Id.* at [0074]. The sectional image is generated based on "a sectional shape appearing when at least the workpiece W is cut along a predetermined cutting plane, and the shape of the workpiece W which is located behind the predetermined cutting plane." *Id.*; *see also id.* at [0075]-[0076], [0023]-[0028].

C. Mori is not in the same field as the '324 Patent

In the proposed Mazumder-Mori combination, Petitioner presents its theory why Mori is analogous art, arguing that it is in "the same field identified in the '324 patent." Pet. 12; *Donner Tech. v. Pro Stage Gear, LLC*, 979 F.3d 1353, 1359 (referring to the "reasonable-pertinence theory" and "same field of endeavor" theory); *Qualcomm Inc. v. Apple Inc.*, 134 F.4th 1355, 1367 (2025) ("[A]n IPR

petitioner is the 'master of its own petition.'") (quoting *Intuitive Surgical, Inc. v. Ethicon LLC*, 25 F.4th 1035, 1041 (Fed. Cir. 2022)). Petitioner clearly argues that both Mori and '324 Patent are purportedly in the field of "three-dimensional fabrication." Pet. 12 (citing EX1001 at 1:14-20); *see also* EX2010 at 68:9-69:5.

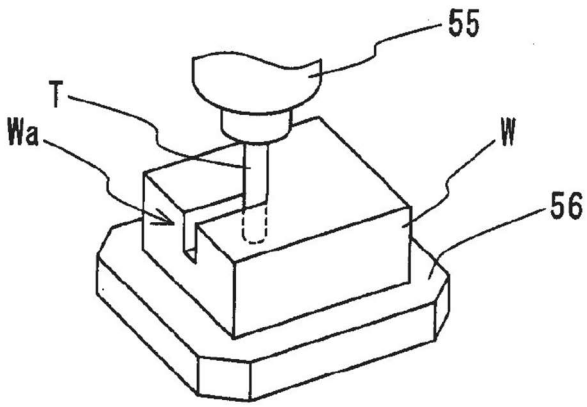
Consideration of whether Mori is analogous art should begin and end with Petition's sole theory that Mori is in the same field as the '324 Patent. *See* Consolidated Trial Practice Guide (84 Fed. Reg. 64,280 (Nov. 21, 2019)) ("Practice Guide") at 74 (cannot proceed "with a new approach as compared to [prior] positions"). To the extent Petitioner seeks to introduce or switch to belated arguments as to why Mori is analogous art, such as a reasonable-pertinence theory, doing so is improper. While a petitioner is not required to present its argument on analogous art in the petition, it remains the master of its petition and may present its argument in the petition, which defines the scope of the IPR. *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1357 (2018) ("the petitioner's contentions, not the Director's discretion, define the scope of the litigation all the way from institution through to conclusion"). Unlike the petitions in *Corephotonics, Ltd. v. Apple Inc.* that "were ambiguous" and "did not make clear whether" the prior art was in the same field as another or as the challenged patents, Petitioner has clearly chosen to present, as the master of its own petition, its sole theory for why Mori is analogous art, unambiguously arguing that Mori is in "the same field identified in the '324

patent." Pet. 12; *Corephotonics, Ltd. v. Apple Inc.*, 84 F.4th 990, 1004-05 (Fed. Cir. 2023). Thus, it would be improper to introduce or switch to new arguments as compared to the clear and unambiguous arguments in the Petition.

Turning to Petitioner's flawed argument that Mori and the '324 Patent are in the same field, it is clear from the disclosures of Mori and the '324 Patent that Mori cannot be considered to be within the '324 Patent's field of endeavor merely because both relate to three-dimensional fabrication. *See In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992) ("Sydansk cannot be considered to be within Clay's field of endeavor merely because both relate to the petroleum industry."). Mori teaches a destructive machining tool with a machining status monitoring apparatus that switches display based on whether the tool is hidden, whereas the '324 Patent teaches a three-dimensional printer whose operation is controlled by a user interface to a remote user that presents both an image of the build volume and a two-dimensional projection of a three-dimensional model from the same point of view.

Mori's hardware is a destructive machining tool that destructively cuts into a workpiece:

Fig. 10



EX1005, at Fig. 10 (T cutting groove Wa into W), ¶[0069]; *see also id.*, Title, Abstract, [0085] (sectional image generation when tool is hidden from view such as when cutting a groove); EX2009, ¶111.

In contrast, the hardware in the '324 Patent is a three-dimensional printer or additive fabrication. *See* EX1001, 27:20-21 (claiming a "a three-dimensional printer") (claim 1); 28:31-33 (same) (claim 19); Title ("Networked Three-Dimensional Printing"); Abstract ("providing a variety of tools for networked use of three-dimensional printers"), at 1:34-35 (same); Fig. 1 (three-dimensional printer 100), 1:48, 2:17-18; Figs. 3-7 (showing three-dimensional printing environments, methods, and user interface), 1:41-61; 1:65-66 ("using networked three-dimensional printers"); *see also id.* at 1:66-2:5. According to the '324 Patent,

three-dimensional printing refers to additive fabrication or manufacturing. *See* 2:8-16; *see also* EX2009, ¶112.

Mori teaches the introduction of a machining status monitoring apparatus to a destructive machining tool that is hidden from view. EX2009, ¶111. As Mori explains, "the machining status of a workpiece cannot be monitored sufficiently" by actual images because "the tool is hidden by the workpiece" due to the destructive machining process. EX1005, ¶[0004]. As a solution, Mori teaches generating sectional images. *See e.g.*, *id.* at [0021]-[0022], [0024]-[0025], [0085].

In contrast, the '324 Patent teaches providing a user interface to a remote user that presents an image of the build volume of the three-dimensional printer within which the three-dimensional model is being fabricated as an object and a two-dimensional projection of the three-dimensional model that is from the same point of view as the image. *See e.g.*, EX1001 at 24:43-25:5, Fig. 7. Nothing in the '324 Patent indicates a concern with the three-dimensional printer or object being additively fabricated being hidden from view. *See* EX2009, ¶112.

Thus, Mori and the 324 are clearly not in the same field. EX2009, ¶111-12. Accordingly, Petitioner's sole, same-field-of-invention theory for Mori is deficient and thus Mori is not analogous art appropriate for an obviousness challenge.

D. Ground 1A does not teach or suggest claims 1 and 19

Even if Mori is in the same field of invention as the '324 Patent (it is not), Petitioner's misguided understanding and interpretations fail to appreciate the scope of the infringement contentions, language of the claims, and teachings of the Mazumder-Mori combination, which does not teach all elements of independent claims 1 and 19.

Claims 1 and 19 each require "a video camera positioned to capture video of the build volume from a point of view" and a "user interface" that presents "an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." EX1001 at 27:23-35, 28:34-35, 28:42-46.

Regarding the video camera, Petitioner relies on the sensors at Mazumder's local site, which allegedly include "video or television camera 65" that "records the laser-aided DMD process and transmits the images to the local computer 70." Pet. 16. According to Petitioner, Mazumder's "local computer transmits the images 'to the remote computer 95 to be displayed.'" *Id.* at 20. Petitioner states that "the combined video and sensor data is displayed on a 'TV screen'" which is purportedly "a display device that does not include its own computing capability." *Id.*

Regarding the two-dimensional projection, Petitioner asserts that the Mazumder-Mori combination would have provided the user interface with both the two-dimensional projection and image of the build volume from the video camera. *See* Pet. 21 (citing EX1005 (*Mori*) at ¶¶[0043], [0049]-[0050]), 23 (citing EX1005 at ¶¶[0070], [0074]-[0076], FIGS. 4, 7, 10). In Petitioner's view, Mori suggests that the combination would include "'virtual image generating section 18' to provide views of the workpiece and work environment based on the stored model of the workpiece" and the benefits of two types of imaging—video camera images and virtual images. Pet. 22 (citing EX1005, ¶¶[0059]-[0065], [0079]-[0083]).

On this basis, Petitioner presents three flawed theories: 1) Mazumder's video satisfies both types of imaging under Petitioner's interpretation of the infringement contentions (Pet. 22 n.3), 2) the combination teaches presenting the video camera images followed or preceded by presenting the virtual images at the same positions/orientations at different times (Pet. 22-23), and 3) a modification of the prior art references such that both types of imaging are presented at the same time (Pet. 23-24 (citing EX1003, ¶112)).

Petitioner's theories conflict with the actual content of the infringement contentions, the language of the claims, and the teachings of Mazumder and Mori. First, Petitioner's theory that Mazumder alone teaches the claim elements (*see* Pet. at 5, 22 (citing to EX1016, 41-105)) is based on a misinterpretation of the

infringement contentions used to manufacture an argument that the claims do not require a user interface that presents ***both*** an image from a video camera and a two-dimensional projection from the point of view of the video camera. According to Petitioner, the contentions assert that the same image(s) can satisfy both the image and projection because they are based on video camera captures. *See* Pet. 22. Under this flawed interpretation, Petitioner asserts that Mazumder's video images "satisfies both of these requirements." *Id.*

However, Petitioner's interpretation is incorrect and unsupported. For example, the contentions point to a "camera view" and "2-D projection of a 3-D model for [a] cute little dinosaur." *See* EX1016, 41-44. As another example, the contentions point to a "time lapse." *Id.* at 46. Notably, there is no allegation that presenting the same image(s) or video satisfies presenting both an image and a 2-D projection. Thus, Petitioner has misconstrued the infringement contentions. *See* Pet. 22 n.5. Accordingly, Petitioner's assertion that "Mazumder's disclosure of video images" satisfies the claim elements is incorrect because there is no basis for Petitioner to assert that presenting the same image(s) is sufficient. Thus, Petitioner's first theory fails to show that the combination teaches or suggests all elements of the independent claims. EX2009, ¶117.

Second, Petitioner's theory that the combination teaches presenting the video camera images followed or preceded by presenting the virtual images at the

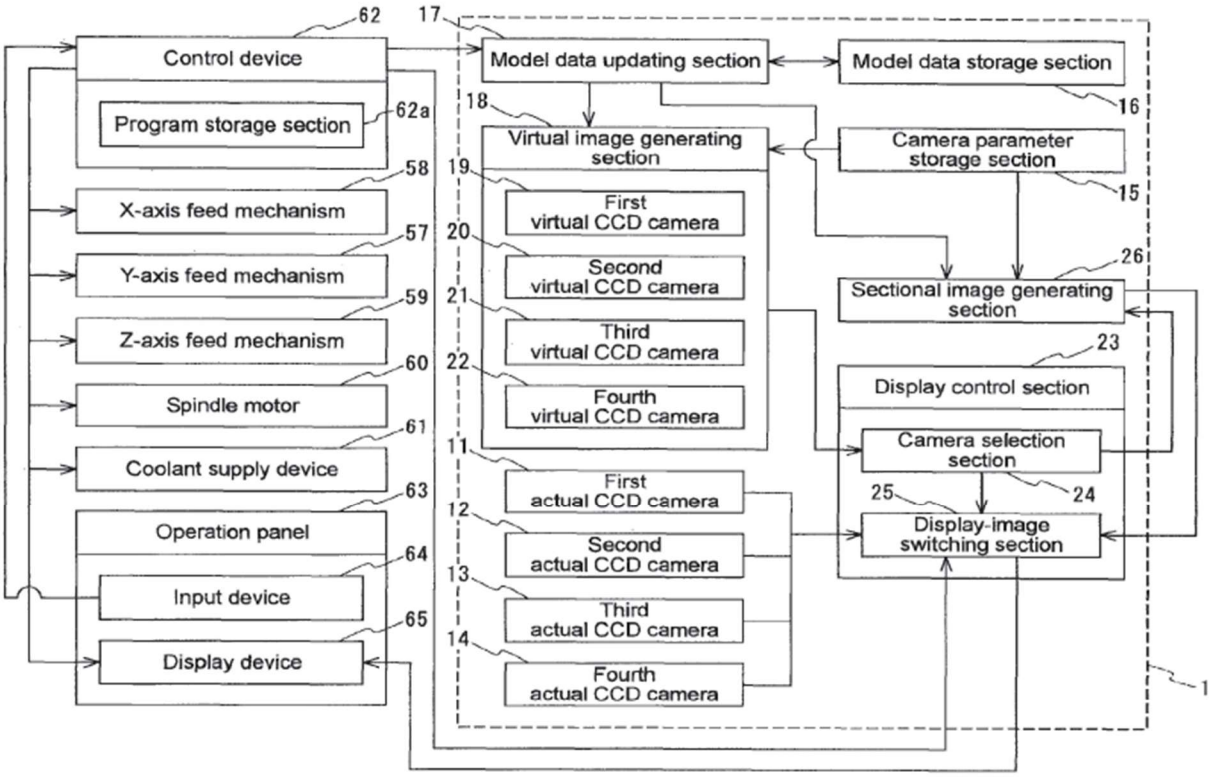
same positions/orientations at different times (Pet. 23) ignores the claim language, specification, and prosecution history of the '324 Patent, as well as the teachings of Mori and Mazumder. As explained, the plain and ordinary meaning of the claims require a user interface that presents both the image and projection together from the point of view of the video camera at the same time. *See* Section IV (Claim Construction). Petitioner's summary of the prosecution history misinterprets the record by mischaracterizing the applicant's argument as simply "a user interface with images from a video camera alone was not enough." Pet. 5. The applicant did not make this particular argument. Rather, both the applicant and the examiner confirmed that the user interface to a remote user presents ***both*** an image from a video camera and a two-dimensional projection ***from the point of view of the video camera*** at the same time, which permits side-by-side comparison. *See* EX1002, 174 (referencing applicant's arguments at *id.*, 160).

Under a proper understanding of the claims, there is no teaching in Mori that the user interface of the combination presents both an image from a video camera and a two-dimensional projection from the point of view of the video camera at the same time. Contrary to Petitioner's assertion that "Mori describes that the user interface displays the actual image data," the "virtual image date [sic]," and "the sectional image data" (Pet. 23), Mori teaches that the user interface only displays one type of image data.

Mori's first embodiment, as described in the Abstract and Summary of the Invention, only displays one type of image data at a time depending on whether the tool is hidden. If the tool is not hidden, actual images are always displayed. *See* EX1005, [0022] (always displaying actual images when tool is not hidden), [0029] (same). Although Mori uses virtual image data to determine if the tool is hidden, it does not display the virtual image data. *See e.g.*, *id.* at Abstract. If the tool is hidden, Mori displays sectional image data. *Id.* at [0024]; *see also id.* at [0023], [0025]-[0028]. Thus, Mori's first embodiment does not teach a user interface that presents both an image and a projection at the same time because it only displays one type of image data depending on whether the tool is hidden. EX2009, ¶¶128-131.

Similarly, Mori's second embodiment displays one type of image data at a time depending on whether the tool is hidden and whether coolant is supplied. In particular, Mori provides a display-image switching section (25) that displays one of three options—actual, virtual, *or* sectional image data.

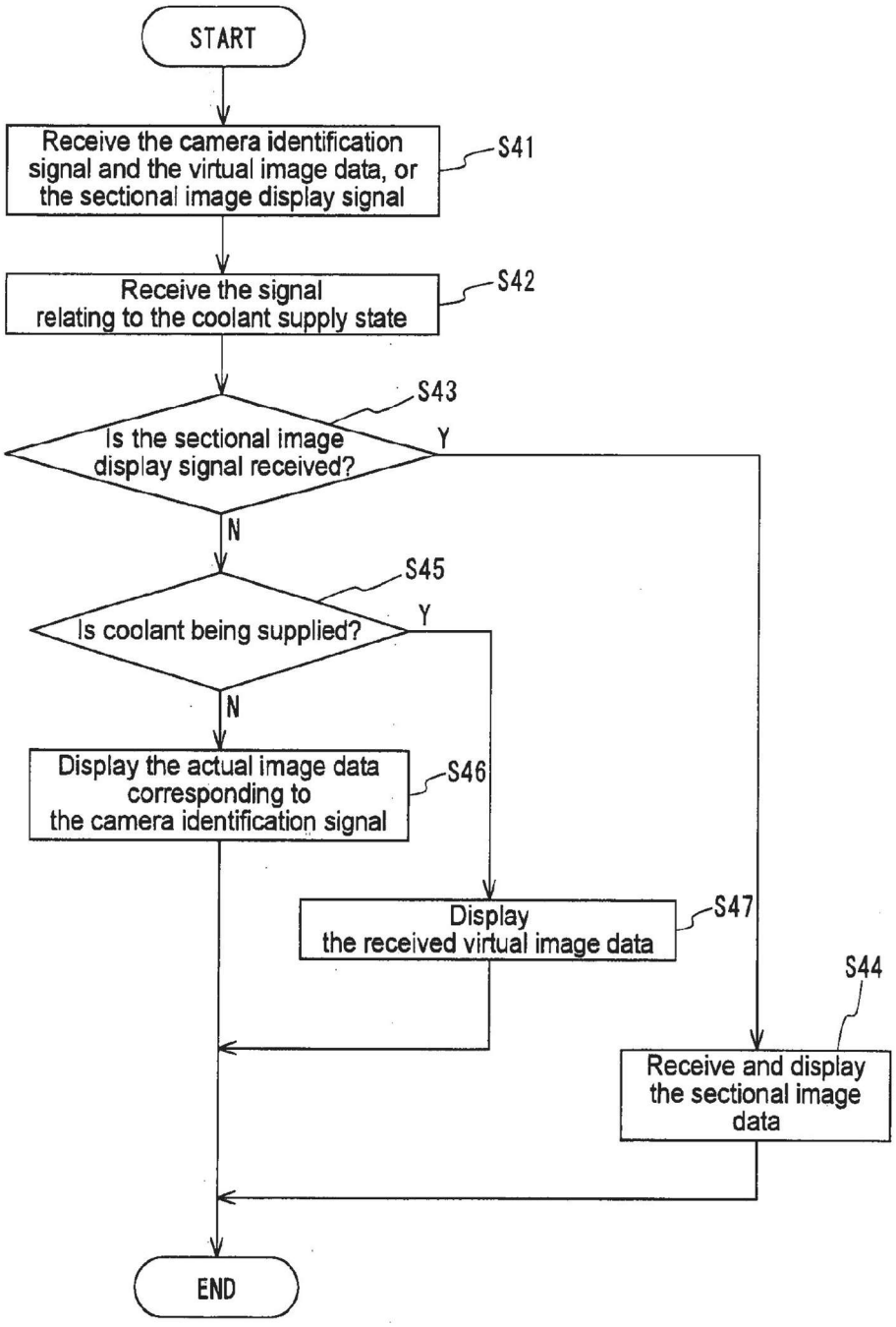
Fig. 1



EX1005, ¶[0070], Fig. 1. While Mori can switch between these three options using the display-image switching section 25, there is no teaching in Mori that, for example, both the actual image data and virtual or sectional image data are presented together in the user interface. EX2009, ¶132.

As shown below in Figure 9 of Mori, the selection between the three options depends on specific conditions.

Fig. 9



Id. at Fig. 9. Sectional image data is displayed (at S44) when the sectional image display signal is received (at S43), virtual image data is displayed (at S47) when

coolant is being supplied (at S45), or actual image data is displayed (at S45) when the sectional image display signal has not been received and no coolant is being supplied. *Id.* at Fig. 9, ¶¶[0071]–[0074]. Thus, Mori does not even suggest a user interface that presents multiple types of image data (the actual, virtual, and sectional image data) at the same time. *See* EX2009, ¶¶132, 134.

When Petitioner's expert, Dr. Wolfe, was asked about Mori's teachings in the combination, he confirmed that he is "taking the imaging capabilities that taught in Mori and applying them to the 3D printer in Mazumder." EX2010 at 51:13-15. In particular, Dr. Wolfe pointed to virtual images in Figure 7 and actual images in Figure 3. *See id.* at 52:4-11 (citing EX1003, p.81); *see also id.* at 52:18-53:2. Dr. Wolfe asserts that it is "clearly the intent of Mori [] to be able to compare those two things." *Id.* at 53:3-13. But, when pressed on where Mori supports this purported clear intent, Dr. Wolfe could only specifically point to Paragraphs 22 and 25 of Mori and admitted that he failed to "give an opinion on Figure 9 of Mori" in his declaration. *See id.* at 53:14-55:14; *see also id.* at 61:5-11. As discussed above, neither of these portions of Mori teach presenting both the virtual (or sectional) and actual images at the same time.

Tellingly, Dr. Wolfe's testimony shows that he has failed to appreciate the complete teachings of Mori. As explained above, Mori teaches, as shown in Figure 9, displaying actual images when coolant is not supplied and virtual images when

coolant is supplied. EX1005, Fig. 9. Mori also teaches that sectional image data is displayed (at S44) when the tool is hidden. *Id.* at Fig. 9, ¶[0072], Fig. 8 (steps S32 and S37), ¶[0069].

Dr. Wolfe believes Mori makes decisions based on coolant supply because "if there's a coolant problem . . . it would be important to display the actual image." *See* EX2010, 61:12-19; *see also id.* at 63:6-9 ("And I don't think that the teachings of Mori with regard to showing images are in any way dependent on the way that it makes decisions related to cooling."). The problem with Dr. Wolfe's "coolant problem" rationale is that is not true. Nothing in Mori mentions a coolant problem. Mori discloses supplying cooling to the contact portion of the tool and workpiece based on operator control and that the operator needs virtual images to "visually recognize the machining status." EX1005, ¶¶[0047], [0078], [0087]. A person familiar with destructive machining tools would have understood that the use of coolant to cool the contact portion causes a dispersion that obscures the operator's view. EX2009, ¶133; EX2011, 1; EX2013, 1. Thus, Mori teaches that switching from actual images to virtual images is only necessary when coolant is supplied because the use of coolant obscures the operator's view. *See id.*

Further, as explained above, Mori teaches, as shown in Figure 1, that its solution switches the image to be displayed in display image switching section 25. Dr. Wolfe testified that he is "not sure" if Mori "gives any details" and that it is

"an ordinary video switch." *See* EX2010 at 67:11-17. Dr. Wolfe's apparent unfamiliarity with Mori is striking. Mori clearly describes Figure 9 as "a flowchart showing a series of processes in a display-image switching section of the embodiment." EX1005, [0038]. As discussed above, Figure 9 does not teach presenting virtual or sectional images and actual images at the same time. Similarly, Mori's first embodiment does not teach presenting sectional and actual images at the same time. EX2009, ¶132; *see* EX1005, Abstract, [0022]-[0029].

Mazumder does not remedy these deficiencies in the asserted combination. EX1009, ¶127. As Petitioner tacitly acknowledges, Mazumder does not disclose the display of virtual images. *See* Pet. at 10 (attributing virtual images to Mori), Pet. at 21-25 (only citing to Mazumder (EX1004) when misinterpreting the contentions on Pet. 22 n.3).

Thus, Petitioner's second theory (that the combination teaches the display of both types of imaging arranged at the same positions/orientations at different times) also fails to show that the combination teaches or suggests all elements of the independent claims. EX1009, ¶¶128-135.

Third, Petitioner's theory that both types of imaging would be displayed at the same time misinterprets the teachings of Mori and its combination with Mazumder. In particular, the Mazumder-Mori combination fails to teach or suggest a user interface that presents an image and projection from the same point of view,

which enables side-by-side comparison. Indeed, Petitioner's argument that the combination teaches side-by-side comparison is driven by impermissible hindsight. *See* Pet. 23 (only citing to EX1003, ¶113); *see also* Pet. 11 (citing EX1004, 7:27-28, 2:34-42, 6:24-35; EX1005, ¶¶[0061]-[0062])); EX1003, ¶85 (mirroring the same arguments as Petition). As the Federal Circuit has explained, it is hindsight to use "the invention to define the problem the invention solves" because "when someone is presented with the identical problem and told to make the patented invention, it often becomes virtually certain that the artisan will succeed in making the invention." *Mintz v. Dietz & Watson, Inc.*, 679 F.3d 1372, 1377 (Fed. Cir. 2012); *see also AT&T Services Inc. et. Al. v. Innovative Sonic Ltd.*, IPR2024-01143 (PTAB Feb. 11, 2025) (finding no motivation to combine because of "hindsight bias").

As an initial matter, Petitioner's expert at paragraph 113 simply mirrors Petitioner's argument without evidence. *See* EX1003, ¶113 and Pet. 23-24. Unsupported attorney argument and conclusory expert testimony cannot take the place of evidence and is entitled to little, if any, weight. *See Estee Lauder Inc. v. L'Oreal, S.A.*, 129 F.3d 588, 595 (Fed. Cir. 1997); *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 15 (Aug. 24, 2022) (designated Precedential on Feb. 10, 2023) (citing *Upjohn Co. v. Mova Pharm. Corp.*, 225 F.3d 1306, 1311 (Fed.

Cir. 2000); *Carella v. Starlight Archery & Pro Line Co.*, 804 F.2d 135, 138 (Fed. Cir. 1986)).

Contrary to Petitioner's assertion, a POSITA would not have been motivated to modify the teachings of Mazumder and Mori in the manner proposed by Petitioner and its expert to display virtual (or sectional) and actual images at the same time. *See* EX2009, ¶¶136-140. Mazumder does not teach such a solution. It merely explains that "*metrological instruments* may also be used for perform accurate measurements *to monitor the fabrication process*," that "local computer 70 communicates with a remote computer 95," and that the remote computer 95 "receives input form [sic] a computer-aided design/computer-aided manufacturing (CAD/CAM) software program 105." EX1004 at 2:34-42. Mazumder explains that non-video sensor data can be used for remote control of the process or modification of the product design (*id.* at 6:24-35) and that "manufacturing information includes visual images" (*id.* at 7:27-28). However, there is no teaching or suggestion in Mazumder that video image data is used for comparison or to "make corresponding adjustments to the model" (*see* Pet. 11). Indeed, Mazumder teaches that sensor data, such as optical and acoustic emission sensors, (and not video images) are used to determine the need for corrective measures. *See* EX1004 at 2:43-50, 6:30-35.

Similarly, there is no evidence that Mori supports Petitioner's conclusory assertion. As explained, Mori describes switching different types of images to display and thus, similar to Mazumder, Mori does not teach or suggest in the combination a user interface to a remote user that presents virtual (or sectional) images and actual images at the same time, which permits the remote user to compare the images side-by-side. *See* EX1005, ¶¶[0023]-[0029], [0071]–[0074], Figs. 1, 9; *see also* EX1005, ¶¶[0060]–[0061] (describing virtual image generation and virtual camera arrangement); EX2009, ¶¶138, 128-135 .

Thus, there is no evidence to support Petitioner's third theory that both types of imaging would be displayed simultaneously and thus, the combination fails to reach or suggest all elements of the independent claims.

For this additional reason, Ground 1A fails to teach or suggest all elements of independent claims 1 and 19. *See* EX2009, ¶¶113-140.

Because dependent claims 3, 5-7, 9-10, and 20-22 depend from independent claims 1 or 19, Ground 1A also fails to teach or suggest all elements of the challenged dependent claims and thus fails to show unpatentability for any challenged claim.

E. Ground 1A does not teach or suggest claim 5

Claim 5 recites "wherein the two-dimensional projection is dynamically updated to correspond to a state of physical completion of the object." EX1001,

27:46-48. Petitioner and its expert skip over the differences between three-dimensional printing and destructive machining to assert that the combination teaches claim 5. *See* Pet. 26; EX1003, ¶118. As Petitioner admits, Mori relates to destructive machining, but Petitioner and its expert fail to provide any evidence of why it would have been obvious to adapt Mori's destructive machining teachings to an additive process in the combination. *See id.*

In particular, Mori describes that its virtual and sectional images are generated based on model data for "the entire machine tool 50" including data for the bed, saddles, spindles, table, tool, and workpiece. *See* EX1005 at [0052]-[0054], Fig. 5, [0054]-[0058] (describing Fig. 5); *see also id.* at [0059]-[0064] (discussing Figs. 6-7), Figs. 6-7. For example, Mori calculates the cutting area between the tool and workpiece. *See id.* at [0056]. However, there is no teaching in Mori of how to adapt these teachings for destructive machining to three-dimensional printing. *See id.*; *see also* EX2009, ¶145. Further, Mazumder does not provide any indication of how to generate virtual or sectional images, much less how to update model data for an entire three-dimensional printer. *See, e.g.*, EX1004 at 3:58, 4:47-49. Thus, the references themselves do not provide any indication of how to adapt modeling of an entire destructive machining tool in Mori for an entire three-dimensional printer in the combination. EX2009, ¶145. Further, there is no motivation for a POSITA to use virtual images from Mori's

virtual CCD cameras in a three-dimensional printer because the actual CCD cameras provide an unobstructed view during three-dimensional printing. EX2009, ¶146; EX1005, [0061]-[0062], [0085], Fig. 3; EX1001, Fig. 1. Thus, the combination does not teach claim 5. *Id.*

Further, there would have been no reasonable expectation of success in adapting Mori's model data updates for an entire destructive machining tool for a three-dimensional printer in the combination. EX2009, ¶¶147, 145-145. Three-dimensional printers are additive in nature and thus, unlike Mori's destructive machining tool, the deposition tool paths in three-dimensional printing do not cut into the material being deposited as Mori teaches. *See id.*; EX1005, [0056].

In addition, Petitioner's theory that maps the claim to the display of video camera images, based on Mazumder's disclosure, is also deficient, as discussed below for claim 6. EX2009, ¶143.

Thus, Ground 1A fails to teach or suggest claim 5.

F. Ground 1A does not teach or suggest claim 6

Claim 6 recites "wherein the two-dimensional projection is a video image from the video camera." EX1001, 27:49-50. Petitioner asserts that Mazumder describes displaying a video image from a video camera. *See* Pet. 26. Additionally, similar to Petitioner's alternative theory for claim 5, Petitioner asserts that this

claim element encompasses displaying a regular image from the video camera. *See id.*

In the Mazumder-Mori combination, Petitioner points to the same images in Mazumder for claims 1 and 19 ("an image of the build volume from the video camera") and claim 6 ("the two-dimensional projection is a video image from the video camera"). *Compare* Pet. 20 *with* Pet. 26. In particular, Petitioner points to the images transmitted from Mazumder's local computer to the remote computer to be displayed "on a TV screen or shown on the remote computer monitor as streaming video." EX1004, 6:36-43, 8:14-17 (cited in Pet. 22, n.3 and Pet. 26 (for alternative argument of claim 5 and for claim 6)).

However, under Petitioner's interpretation of the claims, displaying images captured by a video camera alone would satisfy both claims 1/19 and claim 6. As explained above for claim 1, there is no allegation that presenting the same image(s) or video satisfies presenting both an image and a 2-D projection. *Supra* Section VI.D (Ground 1A does not teach or suggest claims 1 and 19); *see also* EX1016 at 41-44, 46. Nor does the '324 Patent suggest that the same image can be both an image of the build volume and a video image from the video camera. *See, e.g.*, EX1001, 22:53-55 (digital still images and video images are different types of images), 22:66-23:2 (capturing a video image from the video camera); EX2009, ¶¶149-151. Thus, Petitioner has failed to show that the combination teaches both

the image of the build volume and the video image, as required by claim 6, because it has pointed to the same images. *See id.*

Thus, Petitioner has failed to show that claim 6 is obvious and that claim 5 is obvious under its alternative theory.

VII. THE PETITION DOES NOT SHOW THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE UNDER GROUNDS 1B THROUGH 1G

The Petition includes six additional grounds (Grounds 1B–1G) that rely on Ground 1A's Mazumder-Mori combination and additional art to challenge claims that depend from independent claims 1 or 19. *See* Pet. 1. Accordingly, Grounds 1B–1G fail to teach all elements of the challenged dependent claims for at least the reasons discussed above for Ground 1A. *Supra* §VI. Thus, Petitioner has also failed to show unpatentability for the claims challenged in Grounds 1B–1G. *See* EX2009, ¶154.

VIII. THE PETITION DOES NOT SHOW THAT CLAIM 8 IS UNPATENTABLE UNDER GROUND 1C

In addition, Ground 1C does not teach claim 8, which recites "wherein the processor is configured to provide credential-based access to the user interface." Petitioner asserts that Hull discloses that a remote user must enter a password to access a local fabrication system and thus in the Mazumder-Mori-Hull combination credential-based access would have been required to access the local site, including the user interface provided by the local site. *See* Pet. 34.

However, Petitioner fails to appreciate Hull's teachings. In particular, Hull discloses that its "remote user" is at the fabrication system of the local site (at a process or control computer[1]) and connects to the remotely-located slice computer to get the sliced files from the slice computer to merge them. *See* EX1008, Fig. 15; EX2009, ¶¶159-162. This file-transfer procedure does not require authentication credentials to access the local site or printer, as Petitioner and its expert contend. *See* EX1008, [0157] (cited by Pet. 34). To connect to a remote computer, Hull's "remote user" must type in the address of the remotely-located "slice computer" and not the process/control computer at the local site of the printer. *See* EX1008, [0157], [0499] (explaining that "remote user" option); *see also id.* at [0458], [0508], [0143], Figs. 46-47; EX2009, ¶161. A POSITA would have understood that a remote user at the process/control computer then provides a password to access the slice computer at the provided address and then "gets" the sliced files from the slice computer to the process/control computer. *See* EX2008, [0157]; EX2009, ¶162. Thus, a POSITA would not have understood that a "remote user" needs a password to access the local fabrication system. EX2009, ¶¶159-163.

[1] Hull refers to the computer in the fabrication system as the process computer or control computer. *See* EX1008, [0458], [0508], [0143], [0248], [0337]; EX2009, ¶160.

Because credential-based access to the local system is not required according to Hull's teachings, there is no rationale for requiring credential-based access for the remote user to access the user interface provided by the local system in the Mazumder-Mori-Hull combination. *See id.*

Thus, Ground 1C fails to teach or suggest claim 8.

IX. THE PETITION DOES NOT SHOW THAT THE CLAIMS 1, 3, 5-7, 9-10, AND 19-22 ARE UNPATENTABLE UNDER GROUND 2A

A. Overview of Kritchman (EX1015)

Kritchman discloses a three-dimensional printing process and apparatus. EX1015, Title, Abstract. Figure 3A of Kritchman shows an apparatus.

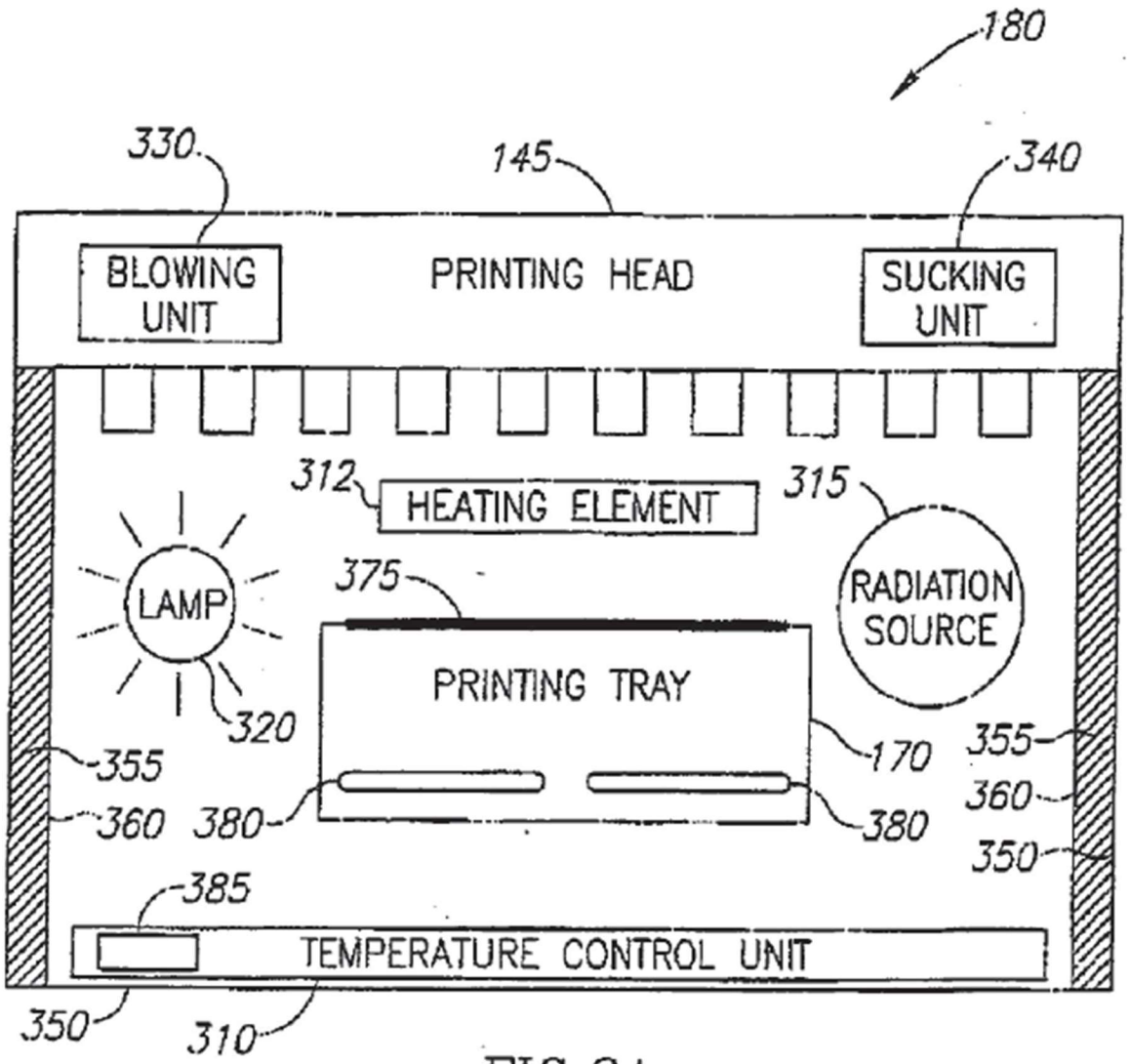


FIG.3A

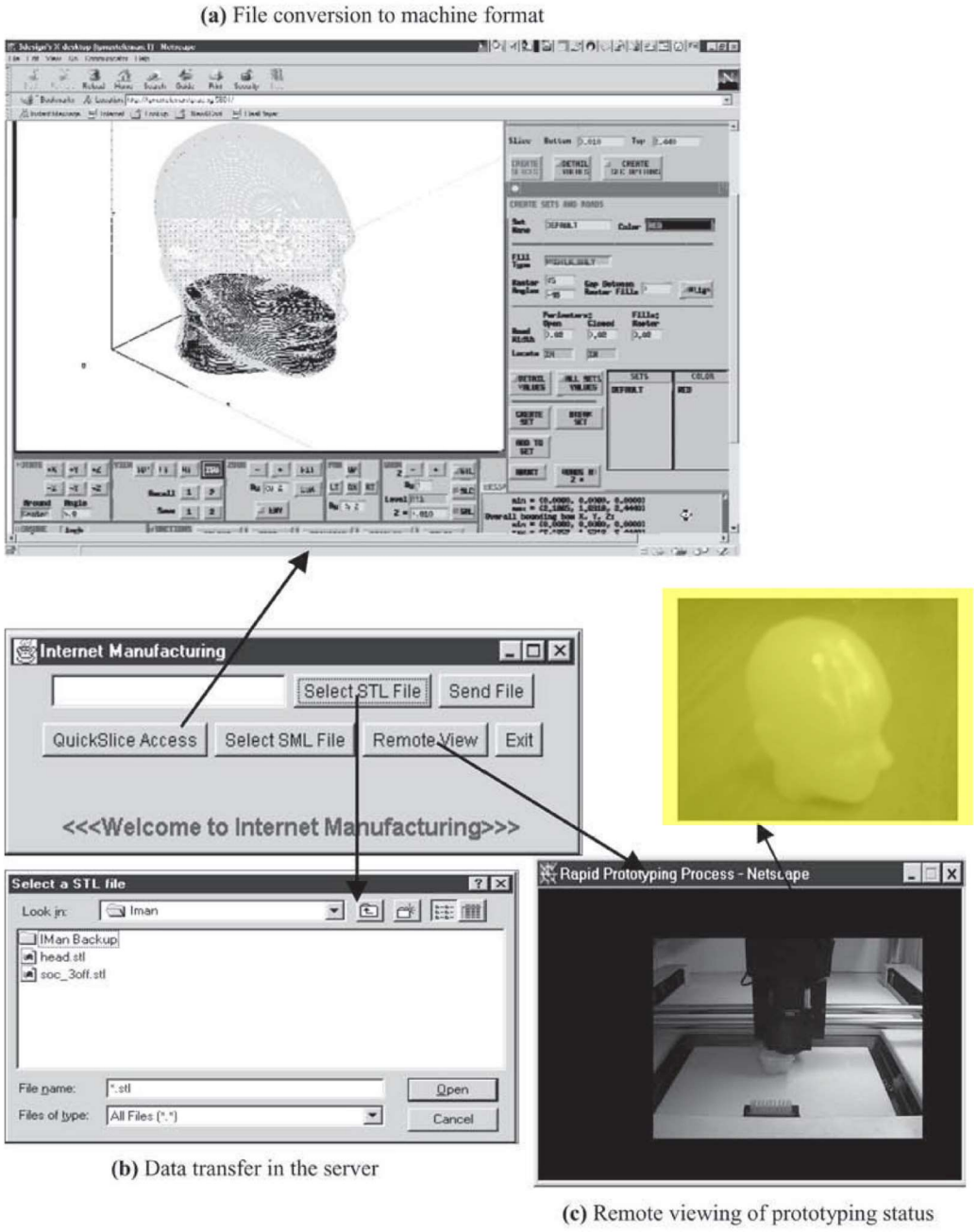
Id., Fig. 3A, ¶[0046]. The apparatus includes printing tray 375 and temperature sensing unit 385. *Id.*, ¶[0099].

B. Overview of Tay (EX1013)

Tay discloses a distributed rapid prototyping framework. EX1013. It describes distributed rapid prototyping via the Internet (*id.* at 1-2), provides a brief description of an Internet Manufacturing (IMAN) system (*id.* at 2-3), describes an

object-oriented architecture of the IMAN system (*id.* at 3-4), and tests and results (*id.* at 4-5). Figure 3 of *Tay* shows several distinct steps with the resulting, completed object annotated in yellow.

Figure 3
(a) File conversion to machine format (b) Data transfer in the server (c) Remote viewing of prototyping status



Id. at Fig. 3.

As shown, step (a) converts the file to machine format with QuickSlice. *Id.* at 4 ("conversion to machine format"), 5 (same). Next, step (b) transfers data in the server. *Id.* at 4 (describing "data transfer"); 5 ("(b) Data transfer in the server"). Then, step (c) concerns remote viewing of the prototyping status. *Id.* at 4 (viewing of "active process"); 5 ("Remote viewing"). Tay explains that multiple remote individuals can concurrently view the prototyping status. *Id.* at 4 ("*concurrently viewing* . . . status."), 1 (viewing "the prototyping concurrently"). As shown by the annotation above in yellow, Tay "show[s] that the quality of the prototype fabricated using the IMAN system is not susceptible to varying conditions of the network link." *Id.* at 4.

C. Overview of Henke (EX1014)

Henke discloses modules for remote engineering applications. *Id.* at 1-2. Henke's solution is designed for students to use simulation tools and existing hardware to "test a designed control algorithm." *Id.* at 2. Henke's "paper starts with an introduction into the design process and describes the tool set, which is provided to the students." *Id.* Henke explains that "[s]imulation and visual prototyping help to find functional errors." *Id.* at 3. For instance, the "physical behaviour of the actual model, and its environment as well, will be emulated (e.g.,

as [a] simulation model)." *Id.* Figure 2 is an example of a visual model for simulating "[w]ater level control."

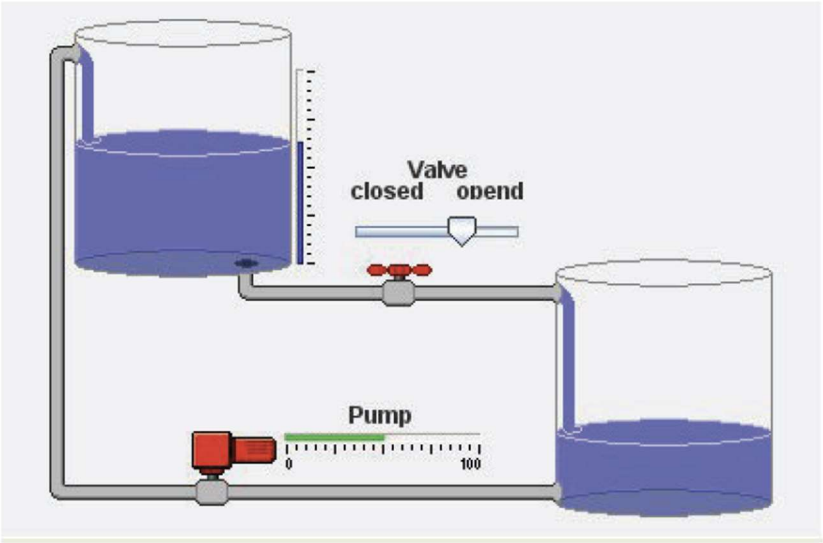


Figure 2. Visual model of the Water level control task

Id. at Fig. 2. Henke explains that "a fault free design algorithm finally should be tested on real electro-mechanical models," such as the "[w]ater level control unit" in Figure 3.

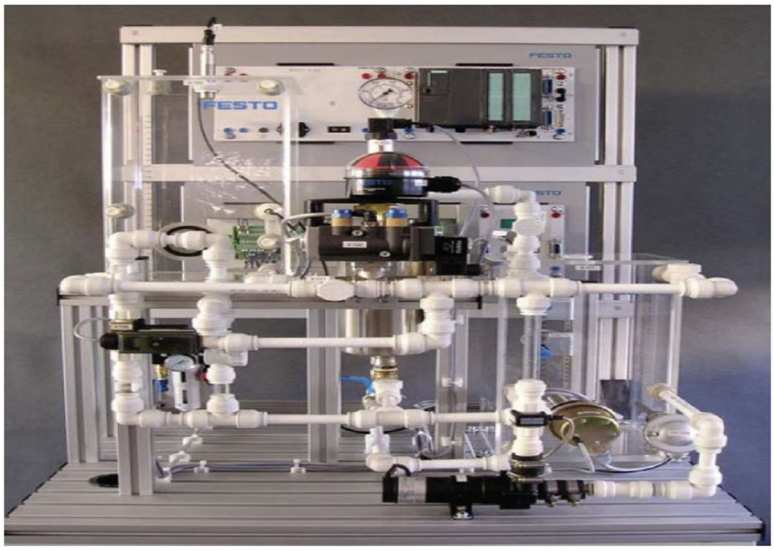


Figure 3. Hardware model of the Water level control unit

Id. at 3. By sharing existing hardware, Henke's "implementation enables a Web-based access to control electro-mechanical models." *Id.* at 1. "The electromechanical models can be controlled by different platforms." *Id.* "Students have the possibility to test a designed control algorithm directly within a hardware environment by uploading a source file to the Remote Lab server. That way the students can compare architectures of different control-platforms as well as different design approaches to control electro-mechanical models." *Id.*

Henke's tool set includes the Remote and Applications Laboratory (REAL) system. *Id.* at 5. The REAL system's features include "[v]isualization and animation [to] allow observing and testing the properties of the design." *Id.* REAL offers an environment for "verification and simulation features to generate and execute a design within visual prototypes." *Id.* Figure 7 shows a visual prototype of off-line, water-level control for verification and simulation.

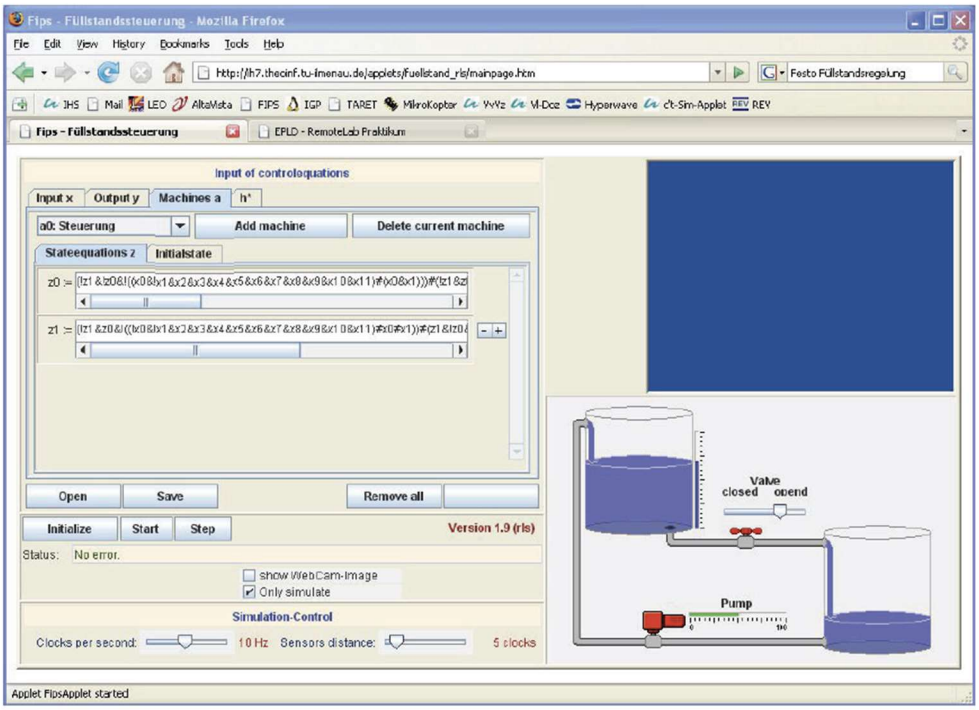


Figure 7. Visual Prototyping (offline control) of the Water level control - without Internet connectivity to the Remote Lab

Id. at Fig. 7.

Thereafter, students can "test their design under real environmental conditions." *Id.* at 5. Figure 8 shows online control of the water-level control.

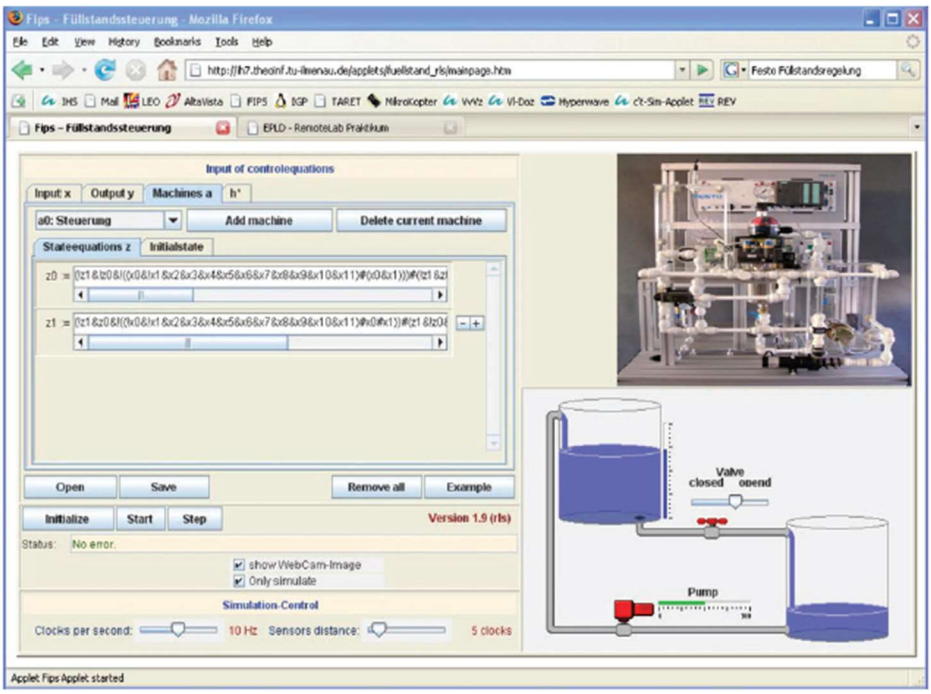


Figure 8. Online control of the Water level control - with Internet connectivity to the Remote Lab

Id. at Fig. 8. Specifically, the student downloads their "synthesized hardware and/or software design algorithms," "handle[s] the laboratory procedure," "change[s] environmental variables if necessary," and "watch[es] the laboratory procedure by supervising the model and environmental variables inside an I/O monitor or by observing the hardware model directly via a Web-Cam." *Id.* Henke explains that "the student has the chance to adjust his algorithm in case of fault" and thus "is able to achieve a fault free solution (a validated control algorithm) step by step." *Id.*

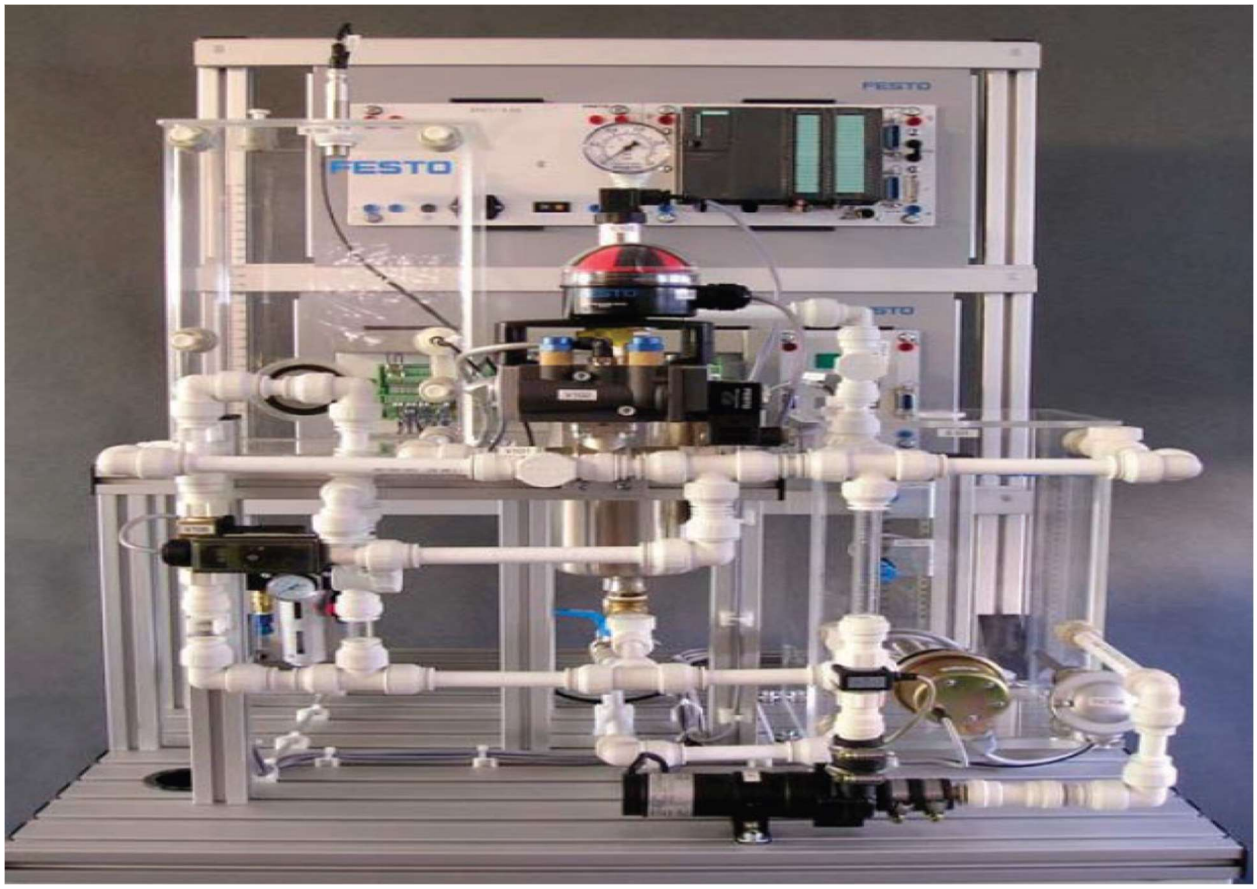
D. Henke is an improper reference for an obviousness challenge

Petitioner relies on the Kritchman-Tay-Henke combination in Ground 2A. Pet. 54-64. However, as explained below, Henke is an improper reference for an obviousness challenge as it is not analogous art.

For a reference to be proper for an obviousness analysis, the reference must be analogous art to the claimed invention. *Clay*, 966 F.2d at 658. Two criteria or theories have evolved for establishing analogous art. *See id.* at 658-59. The first is whether the reference is from the same "field of endeavor" as the claimed invention (even if it addresses a different problem). *See id.* "To determine the applicable field of endeavor, the factfinder must consider 'explanations of the invention's subject matter in the patent application, including the embodiments, function, and structure of the claimed invention.'" *Airbus S.A.S. v. Firepass Corp.*, 941 F.3d 1374, 1380-81 (Fed. Cir. 2019) (quoting *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004)). The second criteria or theory is whether the reference is "reasonably pertinent" to the problem faced by the inventor, as described in the specification of the patent, even if the reference is not in the same field of endeavor. *Clay*, 966 F.2d at 658-59. For a reference to be "reasonably pertinent" to the problem, it must "logically [] have commended itself to an inventor's attention in considering his problem." *In re ICON Health and Fitness, Inc.*, 496 F.3d 1374, 1379-80 (Fed. Cir. 2007) (quoting *Clay*, 966 F.2d at 659).

Under the first, same-field-of-invention theory, it is clear that Henke is not in the same field of endeavor as the '324 Patent. Henke teaches tools for simulating and testing control algorithms, whereas the '324 Patent teaches a three-dimensional printer whose operation is controlled by a user interface to a remote user that presents both an image of the build volume and a two-dimensional projection of a three-dimensional model from the same point of view. *Supra* §II.A (Summary of '324 Patent), VI.C (discussing field of the '324 Patent); *see also* EX1001, Title, Abstract, 1:34-35, 1:41-61; 1:65-2:5, 2:8-16, Figs. 1, 3-7, 24:43-25:5, 27:20-21, 28:31-33; EX2009, ¶¶166-171.

Henke's hardware is a system for testing a water-level control algorithm. *See* EX1014 at 1, 3, 5; EX2009, ¶¶167-168.



EX1014, Fig. 3. As shown, the hardware consists of a water level control unit that is used for testing.

In contrast, the hardware of the '324 Patent is a three-dimensional printer. *Supra* §§II.A, VI.C; *see also* EX1001, Title, Abstract, 1:34-35, 1:41-61; 1:65-2:5, 2:8-16, Figs. 1, 3-7; EX2009, ¶170.

Henke teaches the introduction of remotely testing control algorithms on real electro-mechanical hardware models, such as the water level control unit shown in Figure 3 above. EX1014, at 3 (testing on "real electro-mechanical models"); EX2009, ¶168.

In contrast, the '324 Patent teaches providing a user interface to a remote user that presents an image of the build volume of the three-dimensional printer within which the three-dimensional model is being fabricated as an object and a two-dimensional projection of the three-dimensional model that is from the same point of view as the image. *See e.g.*, EX1001 at 24:43-25:5, Fig. 7; EX2009, ¶170.

Henke does not describe, or even mention, three-dimensional printing. *See, e.g.*, EX1014, Abstract. Nor is there any explanation in Henke of why a three-dimensional printer, which fabricates new 3-D hardware objects and is not for designing and testing new control algorithms on existing hardware, would need to test a control algorithm. *See id.*; EX2009, ¶169-170. Further, nothing in the '324 Patent indicates a concern with remotely testing the control algorithms of the three-dimensional printer. *See* EX2009, ¶¶170, 167-169, 171. Thus, Henke is not in the same field of invention as the '324 Patent. *Id.*

Under the second, reasonable-pertinence theory, it is also clear that Henke is not "reasonably pertinent" to the problem faced by the inventor of the '324 Patent.

Henke's remote tools for simulating, testing, and verifying the functionality of control algorithms allow students to achieve a fault free design algorithm by testing the algorithms on real, shared hardware. EX2014, 1 (encouraging "shared use of equipment," "specialized software," and "simulators"), 3 (testing "on real electro-mechanical models"); EX2009, ¶173.

In contrast, the '324 Patent describes a three-dimensional printer whose operation is controlled by a user interface to a remote user that presents both an image of the build volume and a two-dimensional projection of a three-dimensional model from the same point of view, which enables the user to compare the image and projection side-by-side. *Supra* §II, VI.C; *see also* EX1001, Title, Abstract, 1:34-35, 1:41-61; 1:65-2:5, 2:8-16, Figs. 1, 3-7, 24:43-25:5, 27:20-21, 28:31-33; EX2009, ¶174.

Henke is concerned with reducing travel and improving education by removing the "obstacles of cost, time-inefficient use of facilities, inadequate technical support and limited access to laboratories." EX1014 at 1. Henke also seeks to "benefit people with special needs." *Id.* Further, Henke seeks to share real hardware between students because "disturbances can occur, causing special working conditions" that are "contrary to simulation" and because real hardware should "stimulate student's interest in the design of safety critical control systems." *Id.* at 3-4.

But such problems and concerns are not reasonably pertinent to the problem that the inventor of the '324 Patent was involved with—enabling remote users to control and monitor three-dimensional printers fabricating three-dimensional objects. *See* EX1001, Abstract, 1:32-38, 1:41-61; 1:65-2:5, 2:8-16, Figs. 1, 3-7, 24:43-25:5, 27:20-21, 28:31-33; EX2009, ¶¶173, 174. Moreover, as discussed

above, the hardware in Henke is not structurally similar to the three-dimensional printer hardware in the '324 Patent. *See* EX1014 at 1, 3, 5; EX1001, Title, Abstract, 1:34-35, 1:41-61; 1:65-2:5, 2:8-16, Figs. 1, 3-7; EX2009, ¶174; *supra* §§II.A, VI.C. Nor does Henke's solution fabricate anything, much less an object within a build volume. *See id.* Indeed, a POSITA would have recognized that "rapid prototyping modules" a control algorithm is a distinct problem from "rapid prototyping" by fabricating an object from a model. EX2009, ¶174; EX1001, 1:16-18; EX1014, Abstract. Thus, there is no reason why the simulation and use of existing hardware to test control algorithms designed by students in Henke would logically have commended itself to an inventor's attention in considering the problem of a user interface to provide an image of a build volume and a two-dimensional projection of the three-dimensional model, from the same point of view, which enables a side-by-side comparison. Therefore, Henke is not "reasonably pertinent" to the problem that faced the inventor of the '324 Patent. *See Clay*, 966 F.2d at 559-660 (finding a gel treatment of underground formations to fill anomalies is not reasonably pertinent to a gel that displaces liquid product from the dead volume of a storage tank); *see also Polygroup Ltd. MCO v. Willis Elec. Co., Ltd*, 759 F. App'x 934, 941-42 (Fed. Cir. 2019) (finding no error with Board's determination that a prior art reference used in a three-reference obviousness ground was not analogous art because it "concerned durability rather

than convenient assembly"). Thus, Henke is not analogous art. *See* EX2009, ¶¶166-175.

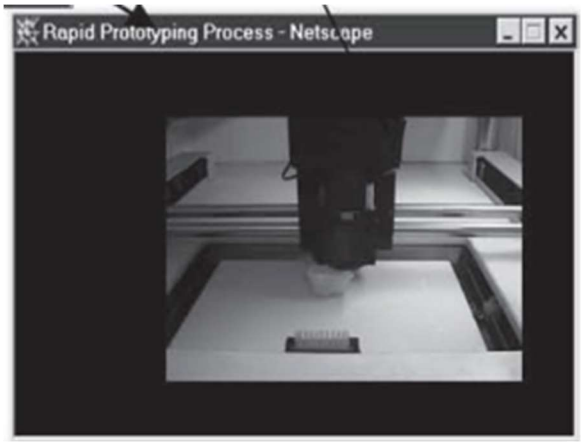
E. Ground 2A does not teach or suggest claims 1 and 19

Even if Henke is a proper reference for an obviousness challenge (it is not), the Kritchman-Tay-Henke combination as asserted by Petitioner fails to appreciate the language of the claims and teachings of Tay and Henke in the combination, which does not teach all elements of independent claims 1 and 19. In particular, claims 1 and 19 each require "a video camera positioned to capture video of the build volume from a point of view" and a "user interface" that presents "an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." EX1001 at 27:23-35, 28:34-35, 28:42-46.

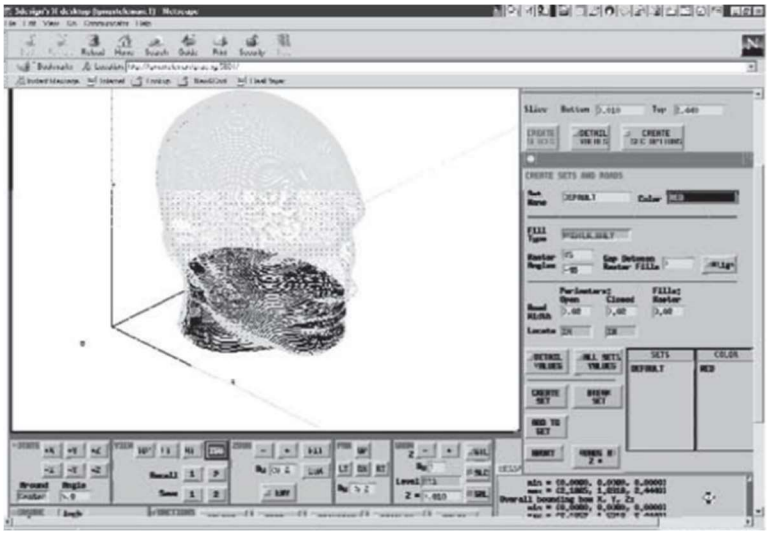
First, Petitioner asserts Tay discloses these claim elements under a flawed view that the claimed user interface can present the image and projection at different times. *See* Pet. 71-72. As explained above, the plain and ordinary meaning of the claims require a user interface that presents both the image and projection together from the point of view of the video camera at the same time. *See* §IV (Claim Construction). Thus, Petitioner's conclusion regarding Tay is based on a flawed understanding of the intrinsic record.

Tay does not teach or disclose a user interface that presents both an image and projection from the same point of view. Petitioner asserts that in Tay's Figure 3, the reference shows a "view of the completed object and the displayed two-dimensional projection of the three-dimensional model appear to be from the same point of view." Pet. 72; *see also* EX1003, ¶226 (parroting the Petition's assertions without any explanation). However, Figure 3 of Tay does not show or describe a user interface that presents both an image and projection from the same point of view at the same time. Rather, it teaches several distinct steps. Step (a) converts a file to machine format with the QuickSlice software, step (b) transfers data in the server, and step (c) concerns remote viewing of the prototyping status. *See* EX1013 at 4-5. Figure 3 of Tay also shows the completed object after fabricated is complete. *Id.* at 4. Notably, Tay does not describe these distinct steps as presenting both, for example, the QuickSlice view shown in step (a) of Figure 3 and remote camera view as shown in step (c) of Figure 3. *See id.*; EX2009, ¶¶178-179.

Further, Tay does not disclose that the two views are from the same point of view. In fact, Tay does not describe the point of view of the remote view at all. *See* EX2009, ¶180. Rather, it only provides a small image of the remote view.



EX1013, Fig. 3 (excerpt for step (c)). There is no teaching that the remote view is from the same point of view as the purported projection or even the distinct image of the completed object:



Id., Fig. 3 (excerpt for step (a)). Further, a POSITA would have recognized that the position of the image in step (a) does not match the position of the image in step (c) on a platform. *See id.* at Fig. 3; EX2009, ¶180. Because of the different positions, a POSITA would have understood that the points of view could not have been the same. *See id.* Further, the point of view of the image in step (c) on the

platform does not match the image of the completed object. *Id.* Thus, Tay does not teach alone or in the combination of Ground 2A a user interface that presents an image and projection from the same point of view at the same time.

Acknowledging Tay's deficiencies, the Petitioner relies on the teachings of Henke in the combination, asserting Henke discloses a video image and model from the same point of view at the same time. *See* Pet. 72-73 (citing Pet., §V.H.4). Petitioner provides two rationales for applying Henke to the Kritchman-Tay system. Pet. 61. The first rationale is to present both video images and a model from the same point of view at the same time, and the second rationale is to add fabrication control functionality to the user interface. *See id.* Relying on Henke's purported suggestions, Petitioner concludes "a POSITA would have recognized" that Petitioner's combination "beneficially allowed an onscreen comparison to quickly identify whether the fabrication process is proceeding correctly and that the object matches the model." *Id.*

However, as explained below, the Tay and Henke references in the Kritchman-Tay-Henke combination both fail to teach or suggest a user interface that presents both an image of the build volume from the video camera and a two-dimensional projection from the same point of view as the camera at the same time.

First, as discussed, Tay does not teach these elements of the claims as Petitioner has a flawed understanding of the intrinsic record and the disclosure of Tay, which among other things, fails to teach presenting an image and projection from the same point of view. *See* EX2009, ¶¶179-180.

Second, Henke has its own deficiencies that fail to remedy Tay's shortcomings. Henke's model is a student-designed control algorithm, such as for water-level control, rather than a three-dimensional model that is fabricated by a three-dimensional printer. *Supra* Sections IX.C-D; *see* EX1014 at 3-4, Fig. 2; EX2010, 82:8-17 (testifying that Figure 2 is "a visualization of the model," which is Henke's "underlying simulation"). As such, Henke's model is a simulation of functionality and not a three-dimensional model (or two-dimensional projection of a three-dimensional model) that is fabricated. *See id.*

Accordingly, the simulation view in Figure 2 of Henke only shows two water levels with a valve and pump whereas the hardware view in Figure 3 shows a much larger system with many components. EX2009, ¶182. Thus, not only is the simulation view in Henke not a two-dimensional projection of the three-dimensional model fabricated by a three-dimensional printer, but it is also not even a two-dimensional projection of what is shown in Henke's hardware view. In light of this, a POSITA would not have been motivated to modify Kritchman and/or Tay to present a two-dimensional projection of a three-dimensional model, as claimed.

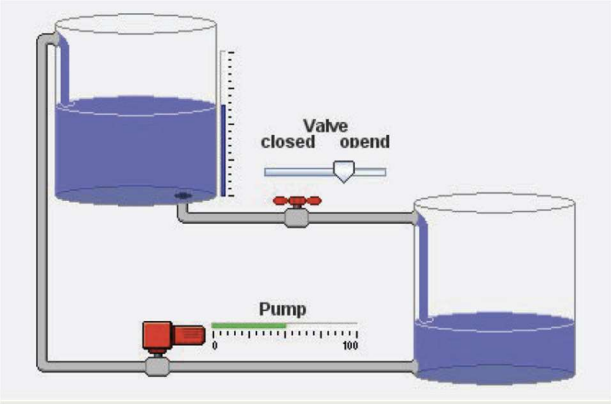


Figure 2. Visual model of the Water level control task

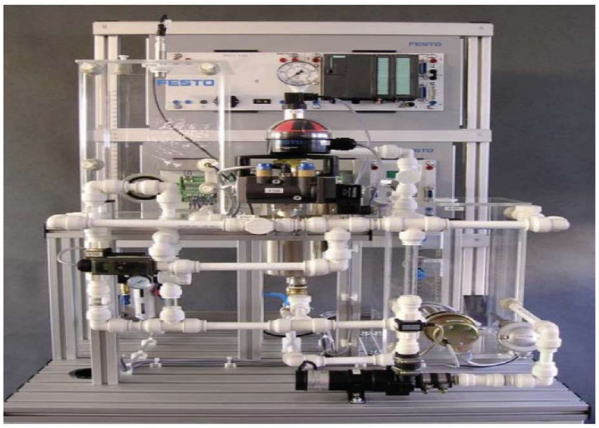
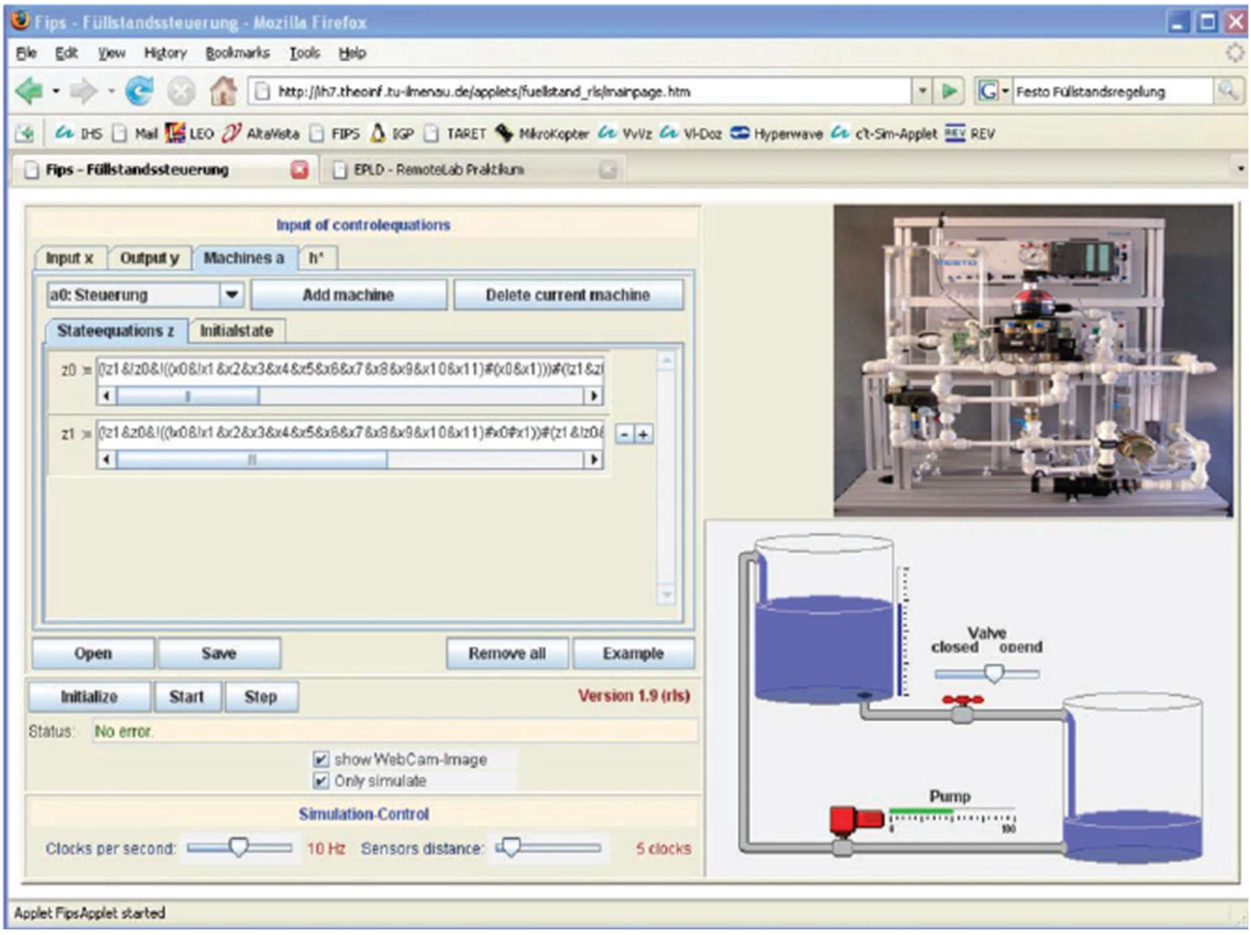


Figure 3. Hardware model of the Water level control unit

Id. at Figs. 2 and 3; EX2009, ¶182.

Further, there is no teaching or suggestion in Henke that its simulation view and hardware view (in Figures 2, 3, and 8) are provided from the same point of view. Indeed, Henke is concerned with testing a function (i.e., a control system algorithm) and not fabrication of a three-dimensional model by a three-dimensional printer. EX1014 at 1, 3, 5, Figs. 2, 3, 8. As shown below, the simulation and hardware have no correspondence because the hardware is not operating or functional, whereas the simulation is operating and functional with partially opened valves and an operational pump.



EX1014, Fig. 8; EX2009, ¶183. Further, Henke appears to recognize the shortcomings of his solution, explaining that, instead of "observing the hardware model directly via a Web-Cam," students can "watch the laboratory procedure by supervising the model and environmental variables inside an I/O monitor." *See* EX1014, 5; EX2009, ¶183; *see also* EX2010, 83:20-84:17 (admitting that the input and output tabs in Figure 8 correspond to Henke's "I/O monitor"). Thus, there is no rationale for providing a simulation and a video of the hardware from the same point of view or to compare the simulation to the video of the hardware, as opposed to just "observing the hardware [] directly via a Web-Cam" or

"watch[ing] the laboratory procedure by supervising the model and environmental variables inside an I/O monitor" as Henke teaches. EX1014, 5. Thus, Henke as applied in the combination with Kritchman and Tay does not teach "a video camera positioned to capture video of the build volume from a point of view" and "to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." EX2009, ¶¶181-183.

For these reasons, Ground 2A fails to teach or suggest all elements of independent claims 1 and 19. And because claims 3, 5-7, 9-10, and 20-22 depend from independent claims 1 or 19, Ground 2A also fails to teach or suggest all elements of the challenged dependent claims and thus fails to show unpatentability for any challenged claim.

F. Ground 2A does not teach or suggest claims 3 and 5

For claims 3 and 5, Petitioner and its expert claim that "the model of the automated process is shown along with the video feed of the actual process" to enable students to use the I/O monitor or Web-Cam. *See* Pet. 74-76. Petitioner contends that the model is updated as the process proceeds. *See id.* But Petitioner's assertions are contrary to Henke's teachings. As explained above, Henke's hardware view in Figure 8 is not operating or functional in contrast to his simulation. *See* EX1014, 5; EX2009, ¶¶184-185. A POSITA would have

understood that Henke's online control can either simulate a control algorithm or test it on hardware, but not both. *See id.* Thus, Henke does not teach in the combination that the purported two-dimensional projection is simulated based on operation of the three-dimensional printer. *See id.*

In addition, Petitioner's theory that maps the claims to the display of video camera images is also deficient, as discussed below for claim 6. *See* EX2009, ¶186.

Thus, Ground 2A fails to teach or suggest claims 3 and 5.

G. Ground 2A does not teach or suggest claim 6

For claim 6 and alternatively for claims 3 and 5, Petitioner asserts that Tay displays a video image from a video camera during fabrication of the object. *See* Pet. 75-76. Petitioner also argues for claim 6 that Henke displays the same thing, despite Henke clearly not disclosing anything about the fabrication of an object. *Supra* Section IX.D. Just as the combination in Ground 1A, Petitioner for Ground 2A points to the same images for claims 1 and 19 and claim 6. *Compare* Pet. 71 *with* Pet. 76. In particular, Petitioner points to the same image (i.e., Tay's remote viewing window) for both the image and claims 1 and 19 and video image of claim 6. EX1013, 4-5.

But, as explained above for claim 1 in Ground 1A, there is no allegation that presenting the same image(s) or video satisfies presenting both an image and a 2-D projection. *Supra* Section VI.D; *see also* EX1016 at 41-44, 46. Nor does the '324

Patent suggest that the same image can be both an image of the build volume and a video image from the video camera. *See, e.g.*, EX1001, 22:53-55, 22:66-23:2; EX2009, ¶¶187-188, 117. Thus, Petitioner has failed to show that the combination teaches both the image of the build volume and the video image, as required by claim 6, because it has pointed to the same video. *See id.*

Thus, Petitioner has failed to show that claim 6 is obvious and that claims 3 and 5 are obvious under its alternative theory.

X. THE PETITION DOES NOT SHOW THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE UNDER GROUNDS 2B THROUGH 2G

In addition to Ground 2A, the Petition includes six additional grounds (Grounds 2B–2G) that rely on Ground 2A's combination of Kritchman, Tay, and Henke in further view of additional asserted art to challenge claims that depend from independent claims 1 or 19. *See* Pet. at 1–2. Accordingly, Grounds 2B through 2G fail to teach all elements of dependent claims for at least the reasons discussed above for Ground 2A with respect to independent claims 1 and 19. Thus, Petitioner has also failed to show unpatentability for any of the claims challenged in Grounds 2B through 2G. *See* EX2009, ¶191.

XI. THE PETITION DOES NOT SHOW THAT CLAIM 5 IS UNPATENTABLE UNDER GROUND 2G

In addition, Ground 2G does not teach claim 5. Petitioner asserts that Anderson in the Kritchman-Tay-Henke-Anderson combination teaches updating a

model to show the completed portion as "filled-in" based on the "number of passes completed by the printhead." Pet. 94-95. But Petitioner ignores the language of claim 5, which requires dynamic updates. Anderson merely teaches updating the fill of a fixed representation based on periodic updates of the pass number.

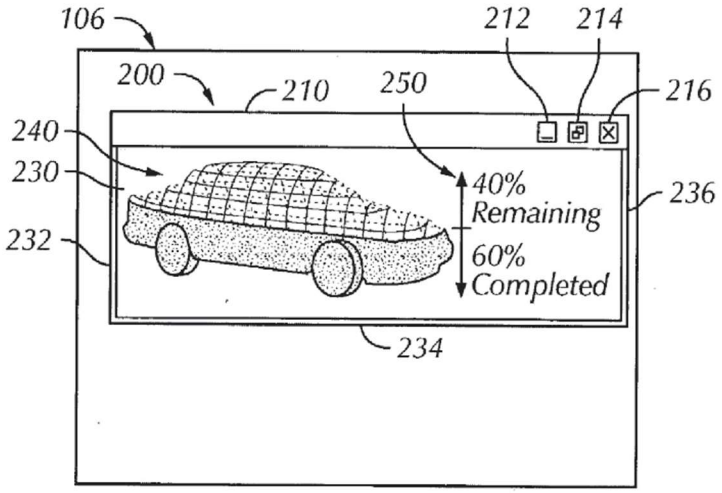


FIG. 2A

See EX1012, [0018], Fig. 2A. A POSITA would have understood that Anderson does not teach dynamic updates, much less dynamic updates to the projection of the three-dimensional object corresponding to a state of physical completion of the object. EX2009, ¶¶193-194; *see also* EX1001, 24:67-5:5. Thus, claim 5 is not obvious under Ground 2G for this additional reason. *See id.*

XII. THE PETITION DOES NOT SHOW THAT CLAIM 8 IS UNPATENTABLE UNDER GROUND 2C

Similar to Ground 1C, Petitioner adds Hull to the combination in Ground 2C. *See* Pet. 86. As explained, because credential-based access to the 3D printer is

not required according to Hull's teachings, there is no rationale for requiring credential-based access for the remote user to access the user interface provided by the controller in the combination of Ground 2C. *See* EX2009, ¶¶195-199; EX1008 at [0157], [0499], [0458], [0508], [0143], Figs. 46-47; *supra* Section VIII. Thus, Ground 2C fails to teach or suggest claim 8 for this additional reason.

XIII. CONCLUSION

For the foregoing reasons, Petitioner has failed to show by a preponderance of the evidence that any of the asserted grounds render any of the challenged claims obvious. The Board should find in favor of Patent Owner and uphold the validity of the challenged claims.

Respectfully submitted,

Dated: September 10, 2025

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), I certify that this Response complies with the type-volume limits of 37 C.F.R. § 42.24(b)(1) because it contains 13,979 words, excluding the parts that are exempted by 37 C.F.R. § 42.24(a), according to the word processing system used in preparation of this Response.

Dated: September 10, 2025 /s/ Brian W. Oaks

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR § 42.6(e)(4), the undersigned certifies that on September 10, 2025, a complete copy of the foregoing Patent Owner's Response was served on Lead and Back-up Counsel for Petitioner at the service address provided in Petitioner's Mandatory Notices:

Email: IPR56224-0014IP1@fr.com

Dated: September 10, 2025

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