UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM, INC. AND AMAZON.COM SERVICES LLC,

Petitioners

vs.

LIGHTGUIDE, INC.

Patent Owner

Case IPR2024-00141
Patent No. 7,515,981

EXPERT DECLARATION OF WILLIAM SINGHOSE IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW

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I. INTRODUCTION

1. I, William Singhose, have been retained as an independent expert by Amazon Inc. ("Petitioner" or "Amazon") in connection with an *inter partes* review of U.S. Patent No. 7,515,981 (the "'981 patent"). I have prepared this declaration in connection with Amazon's Petition for *Inter Partes* Review.

2. Specifically, this document contains my opinions about the technology claimed in claims 1-25 of the '981 patent (the "Challenged Claims") and the grounds against these claims that have been asserted by Amazon. The grounds are as follows:

Challenge	**Claims**	**Basis**	**References**
1A	1-2, 4-7, 11-17, 19-21, 23, 25	103	Poggi and SIMATIC
1B	9-10, 18, 22, 24	103	Poggi, SIMATIC, and Kaufman
1C	3, 8	103	Poggi, SIMATIC, and Pinhanez
2A	1-2, 4-6, 8, 11-12	102	Green
2B	7, 9-10, 23, 14-25	103	Green and Kaufman
2C	3	103	Green and Pinhanez

I was not asked to provide any opinions that are not expressed herein.

II. SUMMARY OF OPINIONS

3. Below, I set forth the opinions I have formed, the conclusions I have reached, and the bases for these opinions and conclusions. I believe the statements contained in this declaration to be true and correct to the best of my knowledge.

4. Based on my experience, knowledge of the art at the time of the applicable priority date, analysis of Petitioner's asserted grounds and references, and the understanding a person of ordinary skill in the art would have had of the claims, in light of the specification, as of the applicable priority date, it is my opinion that the Challenged Claims of the '981 patent would have been anticipated and/or obvious over the asserted grounds.

5. I am being compensated for my time at the rate of $800 per hour. This compensation is in no way contingent upon the nature of my findings, the presentation of my findings in testimony, or the outcome of this proceeding.

III. BACKGROUND AND QUALIFICATIONS

6. I believe that I am well qualified to serve as a technical expert in this matter based upon my educational and work experience. A copy of my *curriculum vitae* is attached as Exhibit 1004 to this petition.

7. I am a Professor of Mechanical Engineering at the Georgia Institute of Technology ("Georgia Tech"). I received a B.S. in Mechanical Engineering

from the Massachusetts Institute of Technology ("MIT") in 1990. I then received an M.S. in Mechanical Engineering from Stanford University in 1992. Finally, I received a Ph.D. in Mechanical Engineering from MIT in 1997. After receiving my Ph.D., I was a postdoctoral researcher at MIT before becoming a professor at Georgia Tech in 1998.

8. Based on my work experience, described in my *curriculum vitae* and in more detail below, I am knowledgeable about the subject matter of the '981 patent and the related prior art. Key elements of the subject matter and prior art include operational aids, sensors, controllers, directional light devices, displays, automation, and interactive computer applications. I have experience working with each of these key elements, and combinations of these elements.

9. My qualifications as an expert in this subject matter stem from my industry work experience, as well as my experience as a Professor in the Woodruff School of Mechanical Engineering at Georgia Tech performing research, teaching, and consulting. I have several patents and hundreds of publications that are directed toward understanding and improving automation, control systems, and operator aids.

10. In my current position at Georgia Tech, I teach courses in mechanical design, system dynamics, and controls. I also lead teams of professors, post-

docs, graduate students, and undergraduate students that conduct research in mechanical design, dynamics, controls, automation, robotics, spacecraft, and human-machine interfaces. During my 25 years at Georgia Tech, I have also had visiting academic appointments at MIT, Stanford, the Polytechnic University of Madrid, and the Tokyo Institute of Technology.

11. Throughout my engineering career, I have worked with automated systems. Before starting my teaching career at Georgia Tech, I worked as a full-time mechanical engineer for several companies, including Walt Disney World, Apple Computers, Inc., and Convolve, Inc. During my tenure at Georgia Tech I have continued to actively work for companies as either a part-time consultant or as a full-time engineer. For example, from 2017-2020 I took a leave of absence from Georgia Tech to work full-time at Google.

12. In my role at Walt Disney World, I designed and developed a number of structures and components for the parks' rides, including operational control procedures for the Body Wars simulators. These simulators were rooms that held about 40 people at a time. The entire rooms, and the guests seated within, were automatically moved up, down, side-to-side, and through a range of inclinations via a series of preprogrammed motions. The machines were equipped with numerous sensors that accurately measured the state of the machine and enabled accurate feedback control of the structure.

13. For Apple Computers, I designed and developed computer monitors with built-in speakers and microphones. Part of my job responsibilities required me to use complex sensors and computer controllers to conduct performance testing on numerous design prototypes that were directed at measuring the effectiveness of the human-machine interaction.

14. For Convolve, Inc., I analyzed the dynamics of automated robots, satellites, and NASA high-altitude balloons. I also developed automated control systems for manufacturing machines, large-scale coordinate measuring machines, and laser interferometer sensors. One of my Convolve projects required the development of a user interface that allowed a user to program the operation of a laser interferometer in order to change its measurement properties.

15. While working for Google, I designed several consumer electronic products and a shopping assistant. The goal of the shopping-assistant project was to guide users to select the best-fitting article for purchase. The product used photographs of the user to generate a 3D model of their body. The product also scanned clothing barcodes to obtain information about a potential purchase. The 3D "avatar" was used in combination with patterns of the clothing to calculate the best-fitting size. During my years at Google, I

worked in both the Advanced Technology and Projects lab (ATAP), as well as the Google augmented reality division.

16. One of the primary focusses of my career at Georgia Tech has been developing technology to aid humans during the operation of machines. The operator-aiding technologies that I have developed decrease the required effort and skill, as well as help reduce operator errors. For example, I have developed technologies that help crane operators move payloads without inducing sway. This makes transferring payloads from one location to another much easier and with less chance of accidents.

17. An important aspect of the subject matter of this case is focused on sensors that are able to detect operational information. The summary of the invention of the '981 patent specifically points out that machine vision can be utilized in the claimed invention. I have a patent covering, and numerous publications describing, the use of computer vision, including:

[1] K. Hekman, C. Stäheli, K. Sorensen, and W. Singhose, "Measuring Crane Payload Swing Angle Through Computer Vision," in *Int. Symp. on Flexible Automation*, Osaka, Japan, 2006;
[2] K. C. C. Peng and W. Singhose, "Crane Control Using Machine Vision and Wand Following," in *IEEE International Conference on Mechatronics*, Malaga, Spain, 2009;
[3] K. C. C. Peng, W. Singhose, and J. Fonseca, "Crane Operation using Hand Motion and Machine Vision," in *ASME Dynamic Systems and Control Conference*, Hollywood, CA, 2009;
[4] M. Freese, S. P. N. Singh, W. Singhose, E. F. Fukushima, and S. Hirose, "Terrain Modeling and Following Using a Compliant Manipulator

for Humanitarian Demining Applications," (Springer Tracts in Advanced Robotics. Berlin, Heidelberg: Springer Berlin Heidelberg, 2010, pp. 3-12;
[5] K. C. C. Peng and W. Singhose, "A Vision-Based Predictive Hook-Tracker for Industrial Cranes," in *International Congress on Sound and Vibration*, Cairo, Egypt, 2010;
[6] K. C. C. Peng, W. Singhose, and P. Bhaumik, "Using Machine Vision and Hand-Motion Control to Improve Crane Operator Performance," *IEEE Trans. on Systems, Man, and Cybernetics - Part A: Systems and Humans,* vol. 42, no. 6, pp. 1496-1503, 2012;
[7] K. Sorensen, W. Singhose, and S. Dickerson, "A Controller Enabling Precise Positioning and Sway Reduction in Bridge and Gantry Cranes," *IFAC Control Engineering Practice,* vol. 15, no. 7, pp. 825-837, 2007;
[8] D. Frakes and W. Singhose, "Geometrically Constrained Optical-flow Based Tracking for the Extraction of Kinematic Data from Video," in *Fifth Int. Symp. on Computer Methods in Biomechanics and Biomedical Engineering*, Rome, Italy, 2001;
[9] K. Sorensen and W. Singhose, "A Multi-Operational-Mode Anti-Sway & Positioning Control for an Industrial 30-Ton Bridge Crane," in *IFAC World Congress*, Seoul, Korea, 2008;
[10] K. L. Sorensen, J. Danielson, and W. E. Singhose, "Anti-Sway and Positioning Control For An Industrial Bridge Crane With Multi-Mode Dynamics," in *ASME International Symposium on Flexible Automation*, Atlanta, GA, 2008;
[11] K. L. Sorensen, W. Singhose, and S. Dickerson, "Combined feedback and command shaping controller for multistate control with application to improving positioning and reducing cable sway in cranes" Patent US 7,970,521, June 28, 2011, 2011.

18. I have also published papers describing research using visual guides to aid workers, such as:

[12] J. Vaughan, A. Smith, and W. Singhose, "Using a Predictive Graphical User Interface to Improve Tower Crane Performance," in *IASTED Int. Conference on Robotics and Applications*, Cambridge, MA, 2009;
[13] J. Vaughan, A. Smith, S. J. Kang, and W. Singhose, "Predictive Graphical User Interface Elements to Improve Crane Operator Performance," *IEEE Trans. on Systems, Man, and Cybernetics--Part A: Systems and Humans,* vol. 41, no. 2, pp. 323-330, 2011;

[14] K. L. Sorensen, J. B. Spiers, and W. E. Singhose, "Operational Effects of Crane Interface Devices" in *IEEE Conference on Industrial Electronics and Applications*, Harbin, China, 2007.

19. Furthermore, I have extensive experience using sensor systems that can accurately locate objects within large workspaces, such as VICON motion capture systems.[1]

20. One of my research projects, which is closely related to the technology described in the '981 patent, mounted a laser on the top of a small-scale tower crane. The laser was directed toward the ground and was controlled such that it indicated to the operator where the crane payload would be about 3 seconds in the future. The laser effectively helped guide the operator to move the crane payload through cluttered environments and arrive at the intended target location. Much like the claimed technology of the '981 patent, the laser-guiding system that we developed used *sensors* to measure the location of the crane body and payload, it had a *controller* that utilized the sensor measurements to issue commands, and it used the *projected light* of the laser to help guide the human operator.

21. I have commercialized operator-aiding technologies by founding two companies: CAMotion Cranes and InVekTek. CAMotion Cranes designed

[1] *See* VICON, www.vicon.com.

and installed crane control systems that decrease payload sway, automatically avoid obstacles, and improve crane safety. These improvements were achieved through sensor systems and control methods that my research group developed, patented, and deployed. CAMotion Cranes was acquired by PAR Systems in 2013. PAR Systems continues to sell the operator-aiding products that we developed. InVekTek develops and commercializes control systems for large robotic and industrial material-handling systems. InVekTek products include control systems that read sensor signals and accurately control machine actuators.

22. Finally, I have previously worked as a technical expert on cases involving warehouse automation equipment. I worked on two investigations at the International Trade Commission (ITC Inv. Nos. 337-TA-1293 and 337-TA-1333), both of which involved warehouse automation equipment that helped workers store and retrieve items in warehouses.

IV. MATERIALS CONSIDERED

23. My opinions are based on my experience, knowledge of the relevant art, the '981 patent, its prosecution history, and the documents discussed in this declaration.

V. LEGAL STANDARDS

24. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents related to this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the Challenged Claims.

A. Claim Construction

25. I have been instructed that the terms appearing in the '981 patent should be interpreted in view of the claim language itself, the specification, the prosecution history of the patent, and any relevant extrinsic evidence. I understand that the words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have had to a person of ordinary skill in the art at the time of the invention. While claim limitations cannot be "read in" from the specification, the specification is often the single best guide to the meaning of claim terms. I have followed these principles in reviewing the claims of the '981 patent and forming the opinions set forth in this declaration.

B. Level of Ordinary Skill

26. I understand a person of ordinary skill in the art is determined by considering issues such as: (i) the type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) the rapidity with which innovations are made; (iv) the sophistication of the technology; and (v) the educational level of active workers in the field. I understand that these factors are not the only criteria that can be applied while proposing a level of ordinary skill. For example, the claimed subject matter can be compared to subject matter that is typically taught in the relevant engineering curricula to provide guidance as to what would constitute appropriate educational requirements for a person of ordinary skill in the art.

C. Anticipation

27. I have been told that under 35 U.S.C. § 102, a patent claim is invalid if its subject matter was patented or described in a printed publication before the effective filing date of the claimed invention. I have been told that this is referred to as invalidity by anticipation. I have been told that a patent claim is anticipated under § 102 if a single prior art reference discloses all limitations of the claimed invention.

D. Obviousness

28. I have been told that under 35 U.S.C. § 103, a patent claim may be found invalid and unpatentable as obvious if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSITA to whom the subject matter pertains.

29. I have been told that a proper obviousness analysis involves:

    a. Determining the scope and content of the prior art;

    b. Ascertaining the differences between the prior art and the claims at issue;

    c. Resolving the level of ordinary skill in the pertinent art; and

    d. Considering evidence of secondary indicia of non-obviousness (if available).

30. I have been told that the relevant time for considering whether a claim would have been obvious to a POSITA is the time of invention.

31. I have been told that a reference may be modified or combined with other references or with a POSITA's own knowledge if a POSITA would have found the modification or combination obvious. I have also been told that a POSITA is presumed to know all the relevant prior art, and the obviousness

analysis may take into account the inferences and creative steps that a POSITA would employ.

32. I have been told that whether a prior art reference renders a patent claim obvious is determined from the perspective of a POSITA. I have also been told that there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention. However, suggestions to combine known elements to achieve the claimed invention may come from the prior art as a whole, or individually, and may consider the inferences and creative steps that a POSITA would employ. I understand that obviousness grounds cannot be sustained by mere conclusory statements and must include some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.

33. I have been told that there is no rigid rule that a reference or combination of references must contain a "teaching, suggestion, or motivation" to combine references. However, I also have been told that the "teaching, suggestion, or motivation" test can be used in establishing a rationale for combining elements of the prior art. I have also been told to be aware of distortions caused by hindsight bias, and that reading into the prior art the teachings of the patent at issue is improper.

34. I have been told that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference, but rather whether a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention.

E. Printed Publication

35. I have been told that a document qualifies as a printed publication for prior art purposes if it was disseminated or otherwise made available to the extent that, prior to the priority date of the challenged claims, persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence could have located it. I have been told that product manuals can be printed publications, to the extent they are sufficiently accessible to those interested and ordinarily skilled in the art before the priority date.

VI. TECHNICAL BACKGROUND

36. U.S. Patent No. 7,515,981 ("the '981 patent") describes a system projecting light to "guid[e] an individual in the performance of operational steps," ['981 patent, 1:16-19], such as in the case of manual manufacturing or manual assembly operations.

37. However, the idea of using light to guide human actions was well known long before the '981 patent. In fact, light sources have been used to provide

guidance signals since ancient times, often to aid its audience in situations of limited visibility. For example, the Pharos of Alexandria is often credited as being the world's first lighthouse built to help mariners navigate the waters, which completed construction in around 280 BCE.[2] Stoplights[3] and spotlights[4] were both developed in the 1800s. As told famously through Henry Wadsworth Longfellow's 1860 poem, "Paul Revere's Ride"[5]—Paul Revere, an American patriot at the time of the American Independence War, created a method of signaling the direction of the British troop's attack using lanterns—"one if by land, and two if by sea"—at which point Paul Revere "will be [] ready to ride and spread the alarm."

38. After the development of light bulbs and lenses, ideas for using guiding lights were extended to areas including manufacturing and assembly tasks. For example, U.S. Patent No. 2,682,117 (the "'117 Patent") (Ex. 1011), patented in 1954, describes an invention using "projected images or light beams" ['117 patent, 7:69] to provide instruction to individuals. One of the

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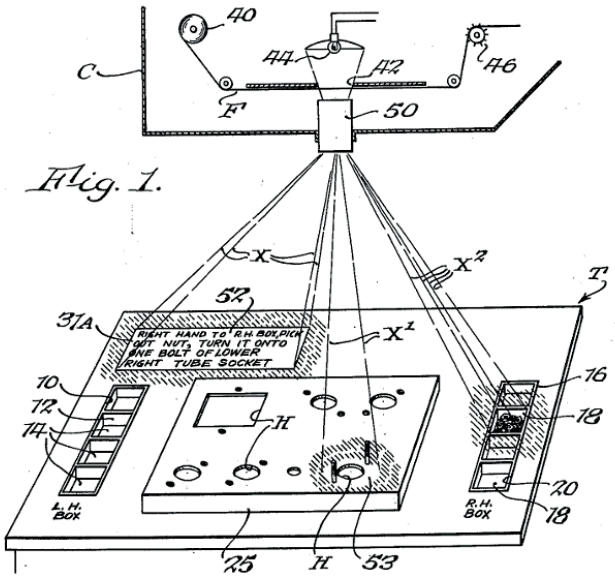
[2] *Lighthouse*, ENCYCLOPEDIA BRITANNICA, https://www.britannica.com/technology/lighthouse; *Lighthouse of Alexandria*, ENCYCLOPEDIA BRITANNICA, https://www.britannica.com/topic/lighthouse-of-Alexandria.
[3] *Traffic light*, Wikipedia, https://en.wikipedia.org/wiki/Traffic_light.
[4] *Spotlight*, ENCYCLOPEDIA BRITANNICA, https://www.britannica.com/technology/spotlight.
[5] Henry Wadsworth Longfellow, *Paul Revere's Ride* (1860), https://poets.org/poem/paul-reveres-ride.

embodiments "project[s] light beams … on different areas of the work-piece in a predetermined sequence to indicate to an operator the sequence in which the parts are to be assembled on the work-piece and the areas of the work-piece on which said parts are to be assembled sequentially." ['117 patent, 9:46-10:2] Figure 1 of the '117 patent, reproduced below, illustrates this 70-year-old idea of using overhead projectors to guide an individual's sequential actions.



'117 patent, Fig. 1.

39. By the 1980s, similar techniques were well-known in manual assembly workstations of the printed circuit board industry. For example, a book on printed circuit board assembly published in 1989 describes a light-guided component acquisition action as, "the component to be assembled is presented to the operator either by a unique binning system, or by a light

indicating in which bin the component to be placed is held." [P.J.W. Noble, PRINTED CIRCUIT BOARD ASSEMBLY (1989) (Ex. 1018) at 121.] The book goes on to describe how the projector guides component placement by stating a "projected image on the printed circuit board showing where that particular component is to be inserted, links to the bin." [P.J.W. Noble, PRINTED CIRCUIT BOARD ASSEMBLY (1989) (Ex. 1018), 121.] It is of note that the book teaches that such light-guided assembly "was introduced some two decades ago." [P.J.W. Noble, PRINTED CIRCUIT BOARD ASSEMBLY (1989) (Ex. 1018), 121.] The book provides illustrations and photographs of such light-guided assembly workstations in Figures 10.4 and 10.5, which are reproduced below for convenience:

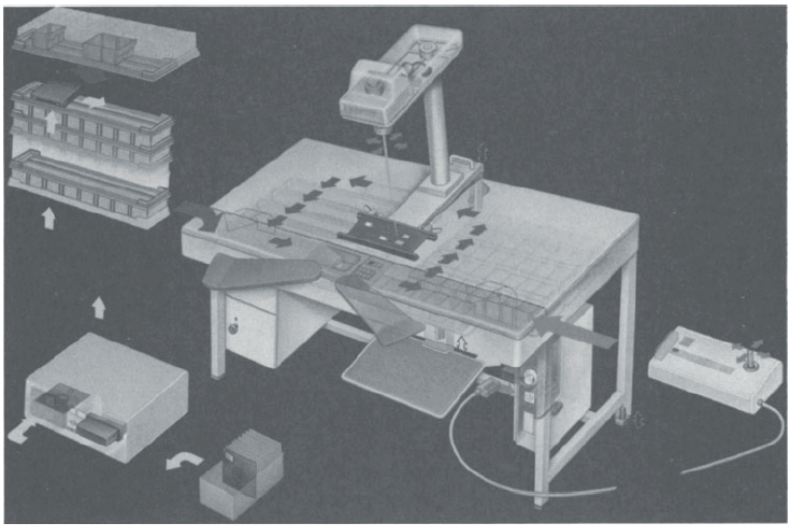


Figure 10.4 A light guided assembly bench

P.J.W. Noble, PRINTED CIRCUIT BOARD ASSEMBLY (1989), Fig. 10.4.

Figure 10.5 A light guided component location – by projected light beam

P.J.W. Noble, PRINTED CIRCUIT BOARD ASSEMBLY (1989), Fig. 10.5.

40. By the 1990s, light-guided techniques were used to replace physical templates in the manufacturing of composite parts.[6] Using laser projectors or other projectors, these systems project images of composite fabric cutouts (also referred to as "layers" or "plies") on a molding tool to guide workers in placing the various layers at precise locations. The assembled layers are

[6] *See, e.g.,* Karen Mason, Laser projection systems improve composite ply placement, CompositeWorld (Mar. 1, 2004), https://www.compositesworld.com/articles/laser-projection-systems-improve-composite-ply-placement (Ex. 1013) ("When laser projection systems first replaced physical templates in aerospace composite layup in the 1990s, the result was nothing short of revolutionary"); *see also* Scott Blake, Improving Manual Manufacturing with a Computer Based Laser Projection System, 102-5 SAE Transactions: J. Materials & Manufacturing (1993) (Ex. 1012).

later compacted and cured to form parts with complex geometries. An example of such a system can be found in U.S. Patent No. 5,506,641 (the "'641 patent") (Ex. 1019) by the Boeing Co. The patent describes a system that projects laser-traced outlines of the respective plies to form a composite part, as illustrated below in Fig. 1 from the '614 patent:

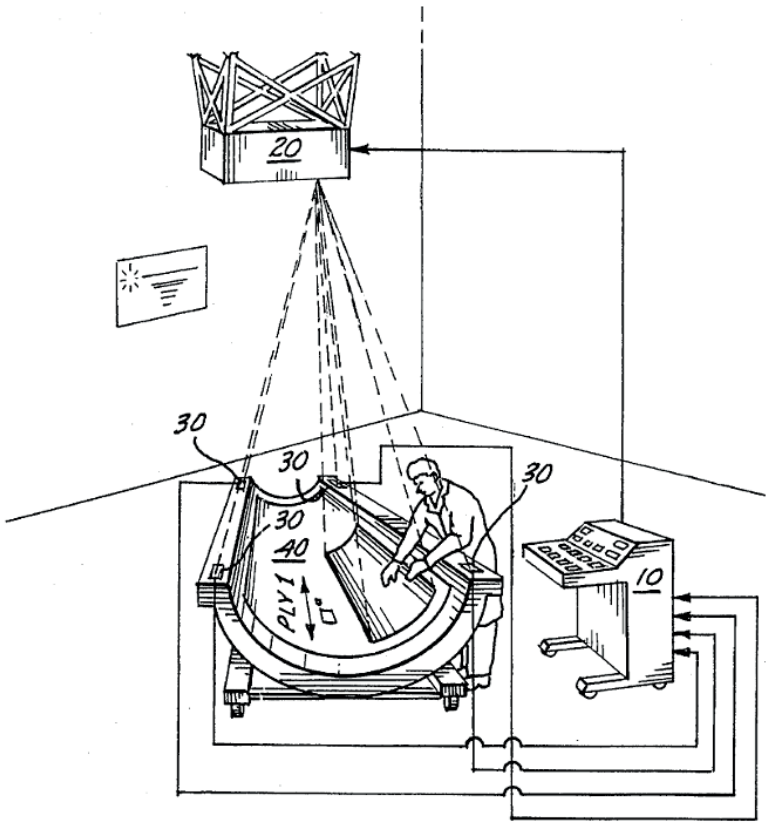


Fig. 1.

'641 patent, Fig. 1.

41. Advancements in camera technology and vision systems capable of tracking an object and detecting the shape of an object allowed for the development of integrated projector-camera (or "procam") systems to produce projections that respond to camera inputs. A large body of academic work emerged in the 1990s and early 2000s using procam systems to create what was later coined "spatially augmented reality." Using these systems, a real-world environment is transformed into an interactive display with projections that respond to the manipulation of real-world objects and user interactions.[7] Some of these systems, including IBM Research's "Everywhere Display," were used to provide contextual instructions to novice users to guide them through various assembly tasks.[8]

[7] *See, e.g.,* Hiroshi Ishii et al., *Tangible bits: towards seamless interfaces between people, bits and atoms*, in Proceedings of ACM SIGCHI Conference on Human factors in computing systems 234-241 (Mar. 1997) (Ex. 1014); Rodney A. Brooks, *The Intelligent Room Project*, in Proceedings 2nd Int'l Conference on Cognitive Technology Humanizing the Information Age 271-278 (Aug. 1997) (Ex. 1015); Ramesh Raskar et al., *The Office of the Future: A Unified Approach to Image-Based Modeling and Spatially Immersive Displays*, in Proceedings of SIGGRAPH Annual Conference on Graphics 179-188 (1998) (Ex. 1016); John Underkoffler et al., *Emancipated pixels: real-world graphics in the luminous room*, in Proceedings of the 26th Conference on Computer Graphics and Interactive Techniques 385-392 (Jul. 1999) (Ex. 1017).

[8] *See, e.g.,* Claudio Pinhanez et al., *Applications of Steerable Projector-Camera Systems,* in Proceedings of the IEEE International Workshop on Projector-Camera Systems at ICCV (2003) (Ex. 1009).

VII. THE ’981 PATENT

A. Specification

42. The ’981 patent was issued to Paul Ryznar and James Ryznar on April 7, 2009. The patent claims priority to U.S. provisional patent application No. 60/724,858 filed on October 7, 2005 and U.S. Provisional Patent Application No. 60/818,058 filed on June 30, 2006, and a non-provisional PCT application filed October 6, 2006.

43. As mentioned above, the ’981 patent describes a system to guide workers that perform sequential actions, for example during the assembly of a product. The guidance provided by the system comes in the form of a projected light that provides visual indicators to the worker while they are performing their sequential actions.

44. A schematic representation of the operational guide system in an assembly line work station is provided in Figure 1 of the ’981 patent, which has been reproduced below for convenience. [’981 patent, 5:20-34, 6:63-7:3].

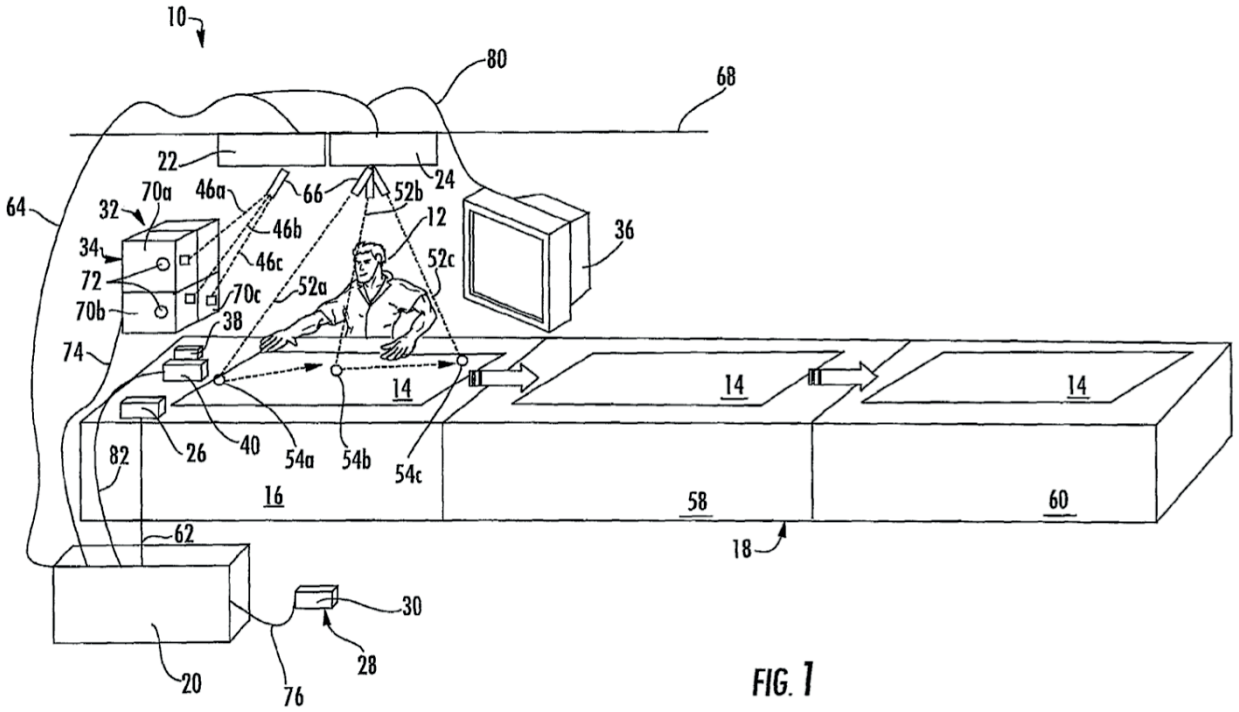


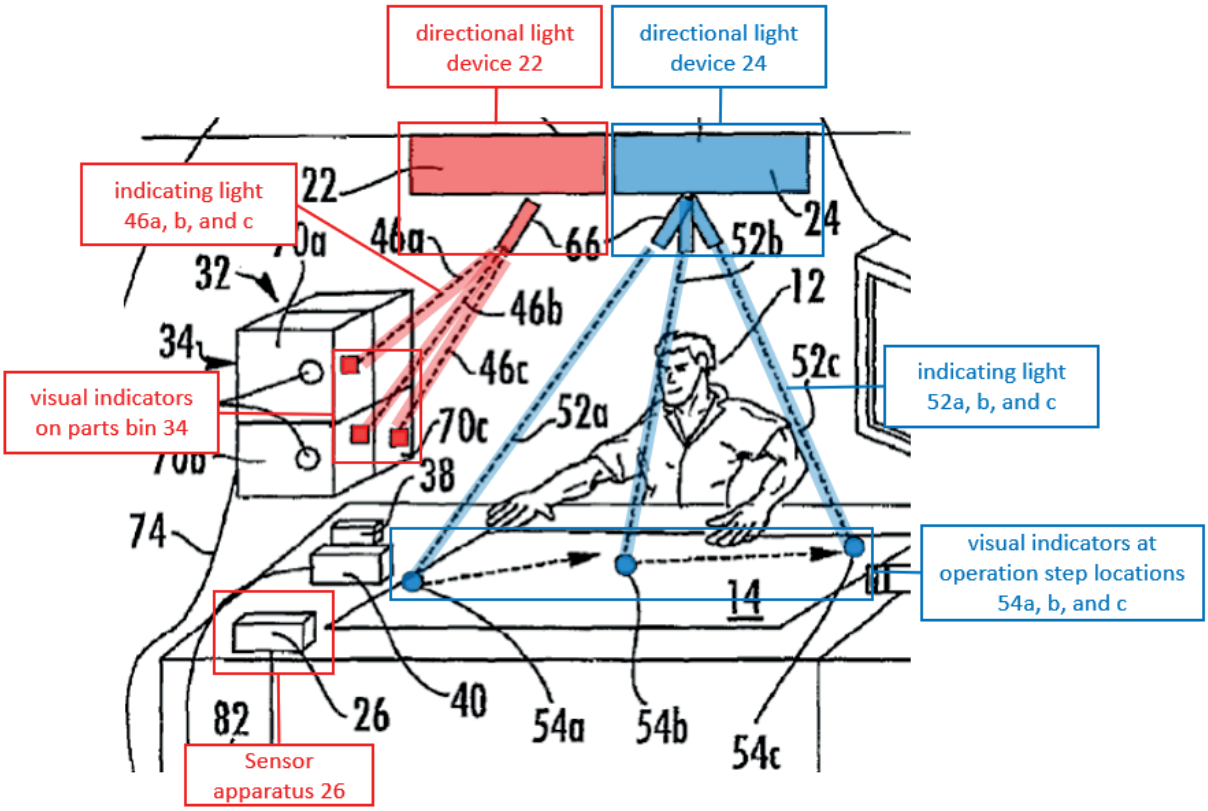
FIG. 1

’981 patent, Fig. 1.

45. The operational guide system includes overhead directional light devices 22 and 24 that project light downward onto the workspace of the operator 12. The projections result in indicating lights 46 and 52 that guide an operator in the selection and assembly of parts.

46. For example, Figure 1 of the ’981 patent illustrates an embodiment including a first directional light device 22 projecting an indicating light at “a location on parts bin 34 to guide the operator 12 to a part required for a particular step in the assembly action,” and a second directional light device 24 projecting indicating light “to indicate the operational step location 54 on the work piece 14 where the selected component is to be installed.” [’981

patent, 4:42-56.] An annotated version of Figure 1 from the '981 patent indicating these significant aspects is provided below.



'981 patent, Fig. 1 - Annotated.

47. In addition, the location and positioning of the projected indicating lights in the '981 patent are directed by a controller that is programmed with the proper positioning information – "the control module 20 and directional light devices 22, 24 of the assembly guide system 10 are programmed as to the proper spatial positioning to where an indicating light 46, 52 is to be projected." ['981 patent, 12:56-59.] The '981 patent refers to this programming as "teaching" – "[t]his *teaching* of the assembly guide system

10 may be accomplished in various ways." ['981 patent, 12:59-61.] "[f]or example, one teaching method involves the use of known pendant device technology, where the pendant device is used to position the projected beam of the light source 66 to a proper location, such as a storage location 70, record the coordinates, and then move to the next location, such as onto the work piece 14." ['981 patent, 12:61-66.]

48. The '981 patent also describes a sensor apparatus 26 that can detect various types of information – "the sensor apparatus 26 detects an *operation information* or *characteristic* or *identification information* associated with the work piece 14, such as, for example, *the presence of and/or the type of work piece* 14 *present at the work station* 16." ['981 patent, 4:38-42.] The '981 patent further teaches that this process can include "read[ing] [] information from [a] tag or bar code when the work piece enters the work station" using "a bar code or radio-frequency system." ['981 patent, 5:52-53, 5:65.] The tag or bar code "may contain information regarding the type of work piece, such as the model of the work piece, measurements related to the work piece, or the type of components required." ['981 patent, 5:46-49.]

49. Given that the claims focus on *operation information*, it is important to understand the scope of that form of information. As noted above, the '981 patent states that "the presence of and/or the type of work piece 14 present at

the work station 16" are examples of *operation information, characteristic,* and *identification information*. However, the '981 patent provides additional examples of *operation information*, such as, "in the case of a part kitting operation, an order request" which includes, "for example, what parts to gather and/or assemble." ['981 patent, 10:60-64.][9]

50. On the other hand, the '981 patent describes *characteristic* and *identification information* as potentially "detect[ing] geometrically distinguishing features of a work piece or the structure upon which it is located." ['981 patent, 5:66-6:2.] The '981 patent goes on to provide examples of *identification*

[9] The '981 patent also contains claims that recite *operational* information. I note that *operation information* and *operational information* may be indefinite because the '981 patent does not provide adequate information from which a POSITA can determine what is *operation information*, what is *operational information*, and what is neither one (or both). However, the dependent claims provide specific examples of *operation information* (e.g., presence/type as defined in claims 4/5) and *operational information* (e.g., cycle time, incorrectly performed action, and other examples from claim 12). I have relied on those specific examples in assessing the prior art and the unpatentability of these claims.

information, such as "the type, location, dimensions, or the like, of the work piece present at the work station." ['981 patent, 6:54-56.]

B. Prosecution History

51. I understand that during prosecution, the Examiner did not issue a rejection of the claims of U.S. Patent Application No. 11/909,002, that later issued as the '981 patent. [*See* Ex. 1002 ('981 patent File History), 205-06.]

52. Instead, I understand the Examiner allowed the claims in the '981 patent because "the prior art taken either singly or in combination fails to anticipate or fairly suggest" all claim limitations of the independent claims. [Ex. 1002, 205.] The examiner pointed specifically to the claim limitations "at least one directional light device, said at least one directional light device selectively operable to project and target at least one indicating light in response to said at least one command signal from said controller," and "to at least one directional light device in response to the identifying of a characteristic; selectively projecting at least one indicating light via the directional light device in response to the first command signal." [Ex. 1002, 205.] The Examiner did not cite to or consider any of the prior art references Amazon's challenges are based on.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

53. In my opinion, a person of ordinary skill in the art ("POSITA") pertinent to the '981 patent would have had at least a four-year degree in electrical engineering, mechanical engineering, computer science, or a closely related field, and at least a year of experience working in interactive computer applications. Additional education could substitute for professional experience, and significant work experience – such as designing or implementing interactive computer applications – could substitute for formal education.

54. I arrived at this definition by considering the various factors listed above in Section V.B. For example, the types of problems encountered in interactive computer applications in the manufacturing industry would include having sensors identify components, work pieces, or user actions in the manufacturing operation. Engineers trained in the above list of disciplines would know how to select, implement, and test sensors capable of automatically identifying components, work pieces, or user actions. Prior art solutions to problems addressed by the '981 patent include automated and semi-automated assembly systems, interactive computer applications, among others. Again, this subject matter would generally fall under electrical engineering, mechanical engineering, and computer science.

55. The claimed technology includes components such as controllers and sensors that are not highly sophisticated: the claimed controller must receive operational information, such as from the claimed sensor apparatus, and then provide command signals in response to the inputs it receives. The controller then operates the directional light device that guides operator actions. Such control systems (controller, sensors, controlled objects, and the code executing on the controller processor) are interdisciplinary technology, but these subjects are generally taught in the junior and senior year of electrical engineering, mechanical engineering, and computer science programs. The particular arrangement of components claimed in the '981 patent would obviously not be taught in undergraduate curriculums; therefore, some amount of practical work experience or additional education would be beneficial to understanding the full scope of the claimed invention. However, specific experience with projected light is not required because, by 2005, projecting light (through the use of digital projectors such as DLP and LCD projectors) was a routine step for displaying output. Furthermore, these projectors were connected to controllers using standard video interfaces such as HDMI. [*See, e.g.* '981 patent, 7:39-49, 8:21-28.]

56. I was at least a POSITA as of the priority date of the '981 patent because I received an undergraduate degree in mechanical engineering in 1990 and I

had worked for more than ten years on control systems for automation-related applications before the priority date of the '981 patent.

IX. CLAIM CONSTRUCTION

57. For purposes of forming my opinions, I have not found it necessary to construe any of the claim language, because the prior art so clearly falls within the scope of the claim language that the core meaning of the claim terms is sufficient for my analysis. Therefore, it is unnecessary to define the precise boundaries of the claim terms.

58. However, I note that at least the term "operational information" in claim 11 and 12 is not used in the specification, and I understand that Amazon has taken the position in related district court litigation that the term is indefinite. Nevertheless, resolving the boundaries of this term is unnecessary for me to complete my analysis, because the prior art discloses at least one of the enumerated examples of "operational information" set out in claim 12.

X. SUMMARY OF THE PRIOR ART

A. Summary of Poggi

59. European patent application publication No. 0,470,901 ("Poggi")[10] was published on February 12, 1992. I have been advised that it thus qualifies as prior art to the '981 patent.

60. Poggi describes an apparatus for aiding workers that are assembling composite parts. [*See, e.g.* Poggi, Abstract, 1:1-3.] Such parts are made by placing layers of cut fabric onto a mold that supports the fabric and holds it in the desired shape. [Poggi, 1:4-9.] Generally, multiple layers of fabric panels and fabric strips are overlaid to create composite parts. [Poggi, 1:4-15.] The fabric pieces are often pre-impregnated with resin. [Poggi, 1:4-15.] After the fabric layers have been properly arranged on the mold, the mold is moved into an autoclave (a large pressurized oven), wherein it is heated for several hours to allow the resin to melt and connect all of the fabric layers. [Poggi, 1:9-11.] The part is then allowed to cool and harden into a structurally stiff assembly that matches the shape of the underlying

[10] A copy of the original French version of Poggi is attached as Ex. 1005 to this petition, and a certified English translation is attached as Ex. 1006. Unless otherwise stated, all citations to Poggi in this declaration refers to the certified English translation (Ex. 1006).

mold. I have personally observed these types of manufacturing processes being conducted.

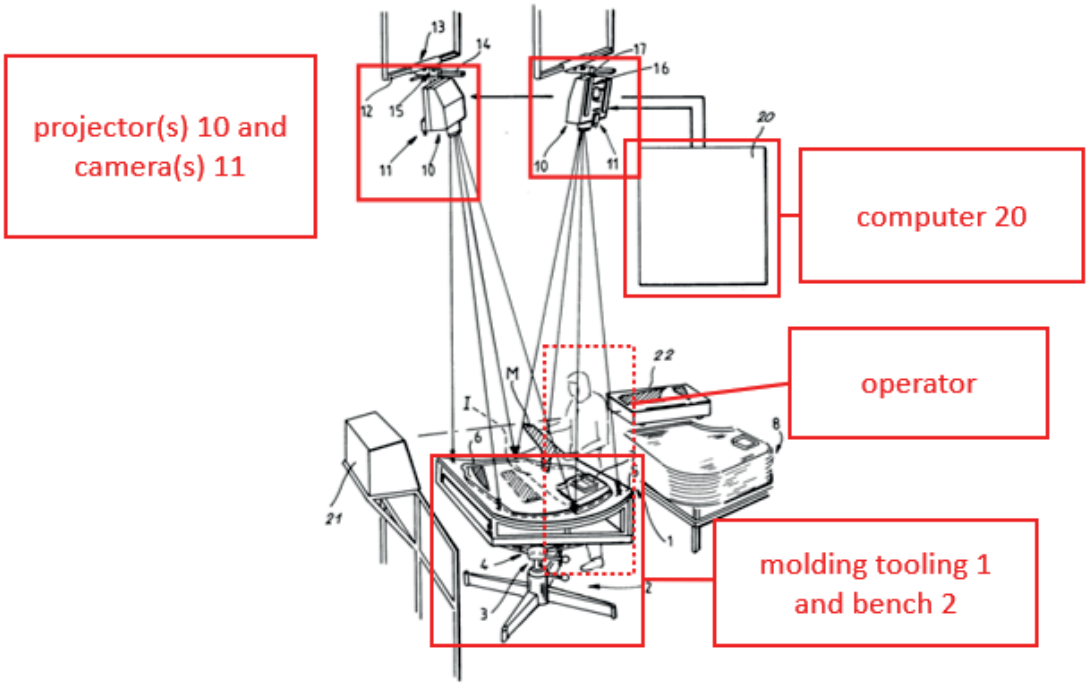
61. Poggi explains that using lights to guide a person through an assembly process is more practical and efficient than guiding people via "lists of written instructions that list the manufacturing steps and drawings that represent the position of each part on the tooling." [Poggi, 1:19-25.] Poggi further notes that, as of 1992, it was "already known" to use "a laser beam controlled by a computer" to outline the correct positioning for fabric cut-outs. [Poggi, 1:26-30.]

62. Poggi improves laser-directed assembly by introducing:

> (1) an image projection system using video projector(s) 10;
>
> (2) "a control system [computer 20] capable of having the image projection system project the images that indicate the exact locations where the layers [fabric cut-outs] must be successively deposited with, if necessary, additional schematic indications to facilitate their placement by the operator," [Poggi, 1:52-57], and;
>
> (3) a molding workstation that aids the operator by having "a lay-up control device [equipped with a camera(s) 11] that verifies that the successive layers [cut-outs] are correctly deposited on the tooling." [Poggi, 1:58-60.] The molding tooling 1 is further supported and

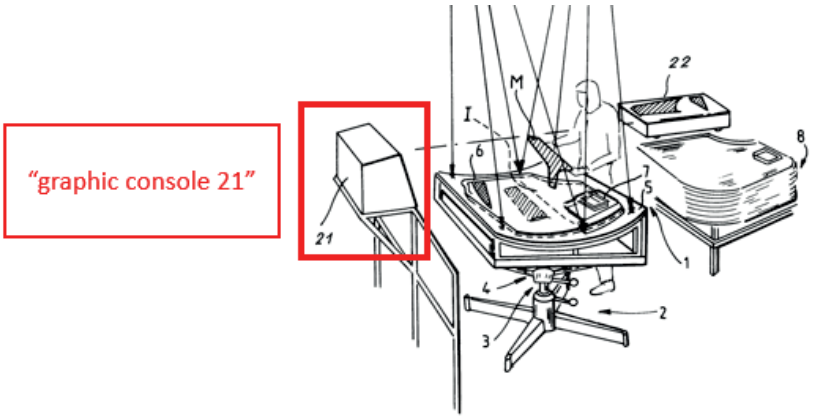
"placed on a height and position-adjustable bench 2" at an operator's work station. [Poggi, 2:28-29.]

These significant components are indicated in the annotated version of Poggi Figure 1 provided below.



Poggi, Fig. 1 – Annotated.

63. In addition, Poggi also discloses one or more graphic console(s) 21 that conveys information about the assembly operation to the operator. This graphic console is indicated in the annotated version of Poggi Figure 1 provided below. [*See, e.g.*, Poggi, 4:9-12.]



Poggi, Fig. 1 – Annotated.

B. Summary of SIMATIC

64. Siemens SIMATIC VS 72X / SIMATIC Spectation Manual (Ex. 1010) ("SIMATIC" or "the SIMATIC Manual") is the product manual for a line of vision sensors from Siemens' SIMATIC VS 720 series. [SIMATIC, 13.] The SIMATIC vision sensors are what are colloquially known as "smart cameras" — cameras with integrated processors able to perform image processing computations. [*See,* SIMATIC, 11, 54, 61.] An image showing one of the SIMATIC vision sensors is shown below in SIMATIC Figure 1-1.

Figure 1-1: Member of the VS 720 Series: the SIMATIC VS 724 Vision Sensor

SIMATIC, Figure 1-1.

65. The SIMATIC manual discloses numerous image-processing features available in the Spectation firmware on the vision sensor [*see* SIMATIC, 54], including (1) detecting the position or location of "parts to be inspected" (i.e. work pieces) [SIMATIC, 6, 112-114 ("Dealing with Part Movement")]; (2) detecting the presence or absence of visual features "that make the part being inspected different from the background" [SIMATIC, 64, 61, 115 ("Presence/Absence Inspections")]; (3) recognizing the shape of parts and finding their edges, such as through "blob" detection [SIMATIC, 91-93 ("Blob Tools")] or "fuzzy logic to detect gradient changes between pixels" [SIMATIC, 106 ("Segmentation SoftSensor")]; (4) detecting 1D and 2D

codes, performing OCR on texts, etc. [SIMATIC, 61, 73 ("Specific Inspection SoftSensor.").]

66. Results from the image-processing steps listed above can be transmitted to a connected computing device, [*see* SIMATIC, 123-129], or can be viewed on a connected computer using Spectation's software user interface. [SIMATIC, 21, 54.]

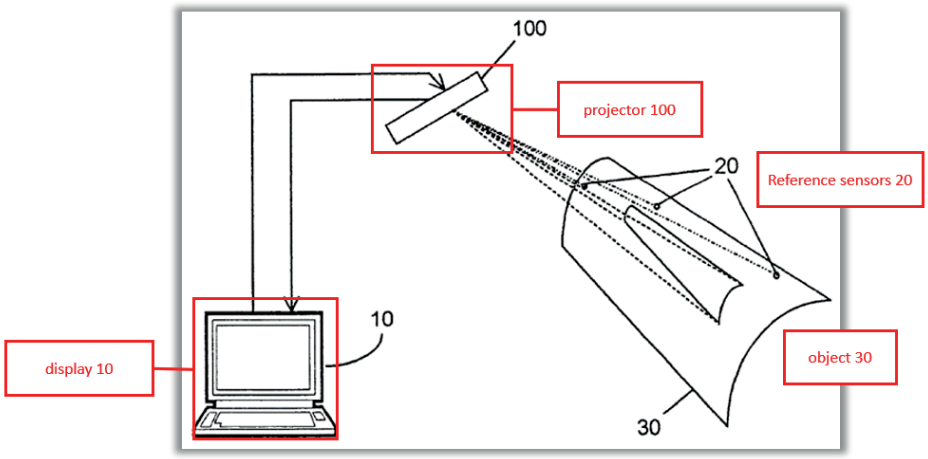
67. The SIMATIC manual is a printed publication that was publicly accessible in the United States at least by June 1, 2005. I have been advised that SIMATIC is thus prior art to the '981 patent. I understand the SIMATIC manual was publicly accessible by June 1, 2005 based at least on the SIMATIC manual itself (e.g. the language "Edition 04/2005" on page 1) and on my own personal experience. Specifically, I received a number of Siemens SIMATIC VS 720 series cameras as part of my collaboration with Siemens starting in 2004, and was provided with a copy of the SIMATIC manual at least by June 1, 2005. The copy of the SIMATIC Manual attached to the petition as Ex. 1010 in this case is a reproduction of the original document that I received and it has remained in my possession since I received it. The SIMATIC manual does not contain any confidentiality requirement and was not distributed under confidentiality agreements. In my experience and personal knowledge, the same manual would have been

distributed to anyone who had purchased a Siemens SIMATIC VS 720 series camera, which, to my personal knowledge were on-sale in the United States before June 1, 2005. Therefore, in addition to my personal knowledge of the public availability of the SIMATIC Manual attached to this petition prior to June 1, 2005, it is also my opinion that the SIMATIC manual was publicly accessible at least by June 1, 2005. The same is true for the October 6, 2006 filing date of the '981 patent and any intermediate date between June 1, 2005 and October 6, 2006.

C. Summary of Kaufman

68. US Patent 6,547,397 (Ex. 1008) ("Kaufman") is titled, "Apparatus and Methods for Projecting a 3D Image." It was filed on April 19, 2000, and issued to Kaufman et al. on April 15, 2003. I have been informed that Kaufman is therefore, considered prior art to the '981 patent.

69. Kaufman describes a laser projector for projecting a 3-D image onto an object, as shown below in the annotated version of Kaufman Figure 1.



Kaufman, Fig. 1 – Annotated.

70. When describing the prior art, Kaufman explains that laser projectors had long been used to project images onto surfaces, including "to assist in the positioning of work pieces on work surfaces." [Kaufman, 1:21-22.] Kaufman explains that "[m]ore recent systems have been designed to project three-dimensional images onto contoured surfaces rather than flat surfaces." [Kaufman, 1:22-24.] Specifically, "[t]he projected images are used as patterns for manufacturing products and to scan an image of ***the desired location of a ply on previously placed plies***. Examples of such uses are in the manufacturing of leather products, roof trusses, airplane fuselages and the like." [Kaufman,1:24-29 (emphasis added).] Kaufman thus contains an explicit statement that 3-D projection systems were available for the application set forth in Poggi well before the priority date of the '981 patent.

71. Kaufman explains that it provides an improvement on such 3D projection systems because, among other reasons, it sets forth "a 3D imaging system utilizing a three-dimensional data set projected onto contoured surfaces where the distance between the laser projector and the work piece platform does not need to be known." [Kaufman, 3:8-11.] Kaufman describes its invention with reference to an assembly action that creates a part by adding multiple "layers." [*See, e.g.*, Kaufman, 8:17-21, 14:53-58.]

72. Like Poggi, Kaufman discloses a projector (projector 100), a control module (controller 210 and associated data storage device 220) (not shown in Figure 1) "that controls the operation of projector 100 in response to various parameter inputs to properly project a 3D image onto a work piece 20," and a "display 10" (also referred to as "operator interface 10.") [*See, e.g.*, Kaufman, 6:58-62, 5:55-57, 12:66-13:2.]

73. As set forth in more detail in Sec. XI.B (Challenge 1B), Kaufman includes more details about the functionality of its "display 10" and associated software program than Poggi does regarding its corresponding "graphic console" and software. Due to the similarities between the system in Poggi and Kaufman, Kaufman's software provides improvement to Poggi's system in the same way that it does for Kaufman's own system.

D. Summary of Pinhanez

74. *Applications of Steerable Projector-Camera Systems* (Ex. 1009) ("Pinhanez") is a paper published by Pinhanez et al. at the IEEE International Workshop on Projector-Camera Systems at ICCV'03 (PROCAMS'03) in 2003. I have been advised that it is thus prior art to the '981 patent.

75. Pinhanez describes a system called the "Everywhere Display." The Everywhere Display ("ED") system included a camera and a projector. [Pinhanez, Sec. 3, ¶ 1.] The ED system was used for guiding humans through a variety of tasks, including "a collaborative assembly task in a factory." [Pinhanez, Sec. 4.1, ¶ 2.] As a "whimsical demonstration" of the assembly task application, Pinhanez demonstrated the use of a projector to guide users in the placement of multi-colored M&Ms to create "a picture made of 3,000 M&M's … where each M&M is regarded as a pixel of the picture." [Pinhanez, Sec. 4.1, ¶ 1.] A pictorial overview of the assembly task is provided in Pinhanez Figure 2, which is reproduced below for convenience.

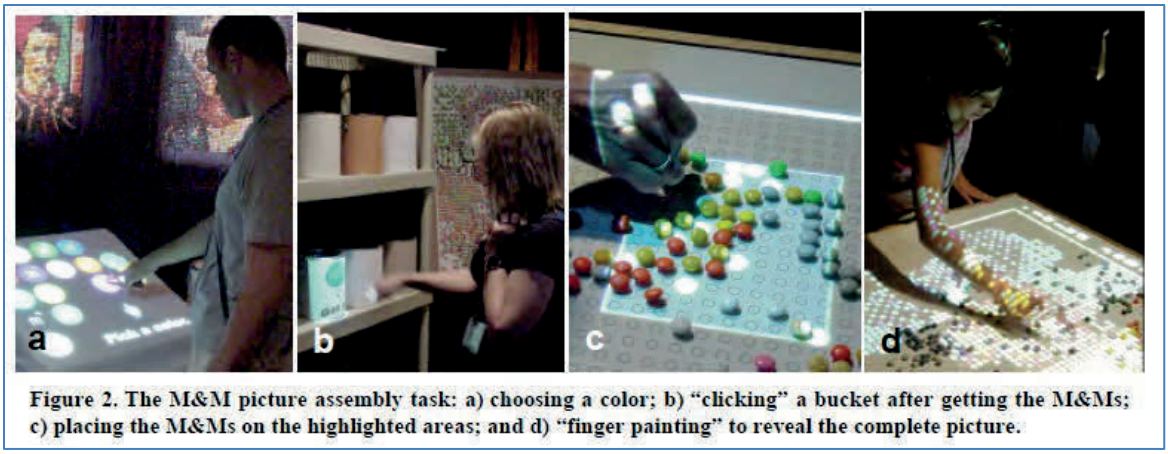


Figure 2. The M&M picture assembly task: a) choosing a color; b) "clicking" a bucket after getting the M&Ms; c) placing the M&Ms on the highlighted areas; and d) "finger painting" to reveal the complete picture.

Pinhanez, Fig. 2.

76. In order to guide the individuals in selecting the correct M&M's, the projector illuminated the buckets where each color of M&M's was stored. [Pinhanez, Figure 2.b; Pinhanez, Sec. 4.1, ¶ 5 ("In Figure 2.b, the system highlights the bucket that contains the M&M's of the selected color and provides additional information on how many M&M's to extract from the bucket.").] The projector then illuminated the locations where the M&M's were to be placed, as shown in Figure 2.c. These illuminations guided the individual to place the M&M's at the correct locations.

E. Summary of Green

77. U.S. Patent Application Publication No. 2007/0236354 (Ex. 1024) ("Green") was filed on August 3, 2005. I have been advised that Green is thus prior art to the '981 patent.

78. Green describes a system and method for performing a ply layup operation to assemble composite panels. [*See, e.g.*, Green, Abstract.] Like the composite parts assembled in Poggi, Green's composite panels are made by placing layers of cut fabric onto a mold that supports the fabric and holds it in the desired shape. [Green ¶ [0020].]

79. Green explains that prior art ply layup operations typically involved using manual visual identification and inspection to ensure that the correct ply was being placed in the correct location, orientation, and sequence. [Green ¶ [0006].] Green's invention is directed at using electronically identifiable tags and sensors capable of detecting those tags to determine the identification, orientation, and location of a ply that has been laid up. Furthermore, Green uses a laser projector to project an outline of the correct location and orientation for the ply onto an operator's work surface. [Green ¶¶ [0008] – [00012].]

80. Green's ply layup system included significant components such as:

(1) a plurality of plies, "such as the ply 22j" [Green ¶ [0023]];

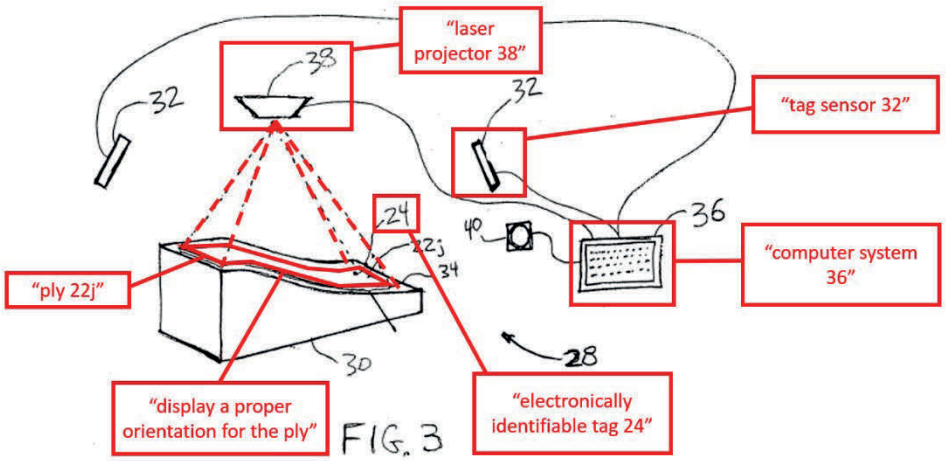
(2) an "electronically identifiable tag 24" embedded in each ply [Green ¶ [0023]];

(3) "tag sensor 32" capable of "scan[ning]/read[ing] each electronically identifiable tag 24" [Green ¶ [0023]];

(4) "laser projector 38" that "display[s] a proper orientation for the ply" [Green ¶ [0023]]; and

(5) "computer system 36," which is "operatively connected to" "tag sensor 32" and "laser projector 38" [Green ¶ [0023].]

These significant components are indicated in the annotated version of Green Figure 3 provided below.



Green, FIG. 3 – Annotated.

XI. ANALYSIS OF PETITION GROUNDS

A. CHALLENGE 1A: Claims 1-2, 4-7, 11-17, 19-21, 23, and 25 are Rendered Obvious by Poggi-SIMATIC

1. Rationale for combining Poggi and SIMATIC

81. A POSITA at the time of the '981 patent would have been motivated to combine Poggi with the teachings in SIMATIC. Specifically, Poggi requires a camera "able to discern the texture, the shape, and position of the layers actually placed on the tooling," [Poggi, 2:9-10], and further able to collect

images that can be compared against reference images to "verify the proper execution of [lay-up] operation." [Poggi, 3:39-41.] SIMATIC discloses a camera meeting these requirements. For example, Poggi's camera "collect(s) square images of 512 pixels per side and are capable of discerning 250 gray levels or, more generally, different shades of color." Poggi, 3:46-49. SIMATIC provides the same or better functionality. SIMATIC, 12 (describing image sensors with up to 1280x1024 pixels and 256 gray levels). SIMATIC's camera can also perform additional useful functions. The SIMATIC Vision Sensor "tak[es] images for the purpose of inspecting them." [SIMATIC, 31]. Specifically, the images captured by the Vision Sensor enable "inspections," or image processing steps, to (1) "detect and count features that make the part being inspected different from the background," [SIMATIC, 64]; (2) detect shapes of the work piece within the images by isolating continuous sub-regions within the images "based on user options," [SIMATIC, 91; *see also* SIMATIC, 91-99 ("Blob Tools," "Template Match SoftSensor," and "ObjectFind SoftSensor")]; (3) recognize colors, such as the "bad colors" associated with a defect, [SIMATIC, 109]; and (4) detect the position of a work piece within the images even as it moves over time [SIMATIC, 112-114]. Thus, a POSITA would understand

that the SIMATIC Vision Sensor can serve as a simple substitution for the cameras in Poggi.

82. A POSITA would understand that combining Poggi with SIMATIC also confers additional benefits. Poggi describes using computer 20 to compare the color, shape, and location of layers of camera images with that of the reference images. [Poggi, 3:53-59, 2:9-10]. A POSITA would understand that by replacing the camera in Poggi with the SIMATIC Vision Sensor, the same step may instead be performed using the Vision Sensor instead of having to perform the computations with Poggi's computer. Given that there are a finite number of locations to perform these computations described in the prior art (i.e., on the camera or on a separate computer), it would have been obvious to try having the computation on the camera.

83. For example, SIMATIC discloses "check[ing] pixel patterns [in camera images] against a learned template" using the Template Match SoftSensor tool. [SIMATIC, 94.] This SoftSensor first separates each image into light and dark pixels based on a user-defined intensity threshold. [SIMATIC, 94.] "The user then selects whether the light, dark or both groups of pixels are used for the comparison … Figures 3-28 shows an image sequence where the part that is present in the first image is being inspected for errors. If only the dark pixels are selected for the inspection, the SoftSensor will verify that

all the original dark pixels are present in subsequent images." [SIMATIC, 94.] SIMATIC Figure 3-28 is reproduced below for convenience. Thus, Template Match in SIMATIC verifies at least the shape and location of layers of objects detected in camera images by comparing them with reference templates.

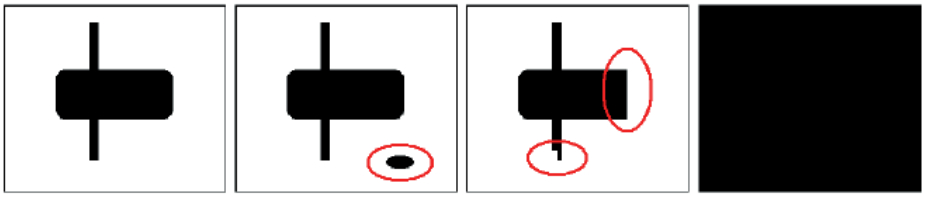


Figure 3-28: Sample images that illustrate the use of only dark pixels for the inspection.

SIMATIC, Fig. 3-28.

84. The same idea in Template Match is taken a step further with ObjectFind SoftSensor, which "learn[s] the characteristics of an object and find[s] occurrences of that object in subsequent images." [SIMATIC, 97; SIMATIC, 97-99.] Instead of a pixel-by-pixel comparison, ObjectFind "extracts a number of features that describes the geometry of the object" from a reference image, and searches for the extracted features "to determine the presence of the learned object." [SIMATIC, 97]. An example of this object-finding feature is illustrated below in Figure 3-31.

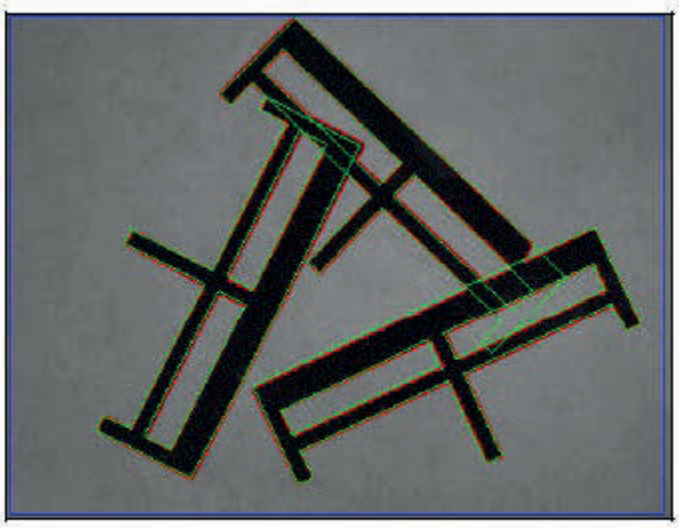


Figure 3-31: Image marking for the ObjectFind SoftSensor

SIMATIC, Fig. 3-31.

85. As another example function, SIMATIC teaches verifying the color of a part using a Color SoftSensor to "detect defects or verify that correct parts are used in an application." [SIMATIC, 109.] "Defect detection can be performed by learning the 'good colors' of a part and detecting any color not in the 'good colors' list in subsequent parts … Part presence can be performed by learning the colors of a number of parts and verifying that the correct part is being used by inspecting subsequent images and comparing the colors present to the desired color." [SIMATIC, 109]. Meanwhile, a variety of SIMATIC SoftSensors "help the user locate the part in the image." [SIMATIC, 112]. Once a user creates a reference from those SoftSensors, it can be used by the positioning SoftSensor, "[t]he positioning SoftSensor locates the part and calculates the shift in position (with respect to the

original position)." [SIMATIC, 112]. Lastly, like the camera in Poggi, SIMATIC discloses working with grayscale images. [*See, e.g.*, SIMATIC, 101.]

86. Another reason that a POSITA would be motivated to combine Poggi and SIMATIC is because smart cameras, such as the Siemens smart cameras described by SIMATIC, were in widespread use by 2005. In fact, I had started using Siemens SIMATIC cameras in the controls courses that I teach at Georgia Tech and in my research activities by 2005. [*See* Michael Robertson & William Singhose, *Evaluation of Analytic Deflection-Limiting Commands*, in Proceedings of 16th IFAC World Congress 598-603 (Jul. 2005) (Ex. 1020); Khalid Sorensen, William Singhose, & Stephen Dickerson, *A Controller Enabling Precise Positioning and Sway Reduction in Cranes with On-off Actuation,* in Proceedings of 16th IFAC World Congress (Jul. 2005) (Ex. 1021); Jason Lawrence & William Singhose, *Design of a Minicrane for Education and Research,* in Proceedings of 6th International Workshop on Research and Education in Mechatronics (2005) (Ex. 1022); Khalid Lief Sorensen, *A Combined Feedback and Command Shaping Controller for Improving Positioning and Reducing Cable Sway in Cranes*, Master Thesis in Dept. Mechanical Eng'g, Georgia Inst. of Tech. (Feb. 2005) (Ex. 1023).]

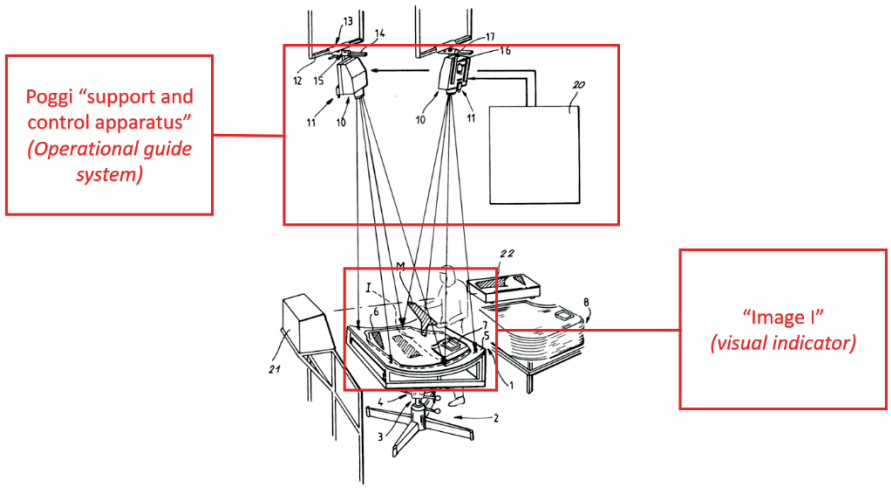
87. Given the widespread adoption of smart cameras by the time of the ’981 patent, a POSITA would have a design incentive to implement Poggi with smart cameras, such as those disclosed in SIMATIC, allows the implementor to take advantage of their image processing capabilities, reduces the complexity of the system, as well as reduces the development effort because an off-the-shelf component (smart camera) is used in place of a component that needs significant engineering development (custom machine vision software). Furthermore, a POSITA would also have a reasonable expectation of success in such a combination because the use of off-the-shelf components is generally easier than custom development of components. In other words, the combination of Poggi and SIMATIC is applying a known technique (SIMATIC) to a known device (Poggi) that yields a predictable result (*e.g.*, simplified implementation).

2. Claim 1 Analysis

[1.0]: “An operational guide system adapted to provide visual indicators to an individual to guide sequential actions, said operational guide system comprising:”

88. To the extent the preamble is limiting, it is disclosed by Poggi. Specifically, Poggi discloses *an operational guide system adapted to provide visual indicators to an individual to guide sequential actions*.

89. As shown in the annotated version of Figure 1 provided below, Poggi discloses "a support and control apparatus in the hand lay-up of composite material parts" [Poggi, 1:1-3] that "[replaces] written list of instructions … [with] projections of images on the tooling." [Poggi, Abstract.]



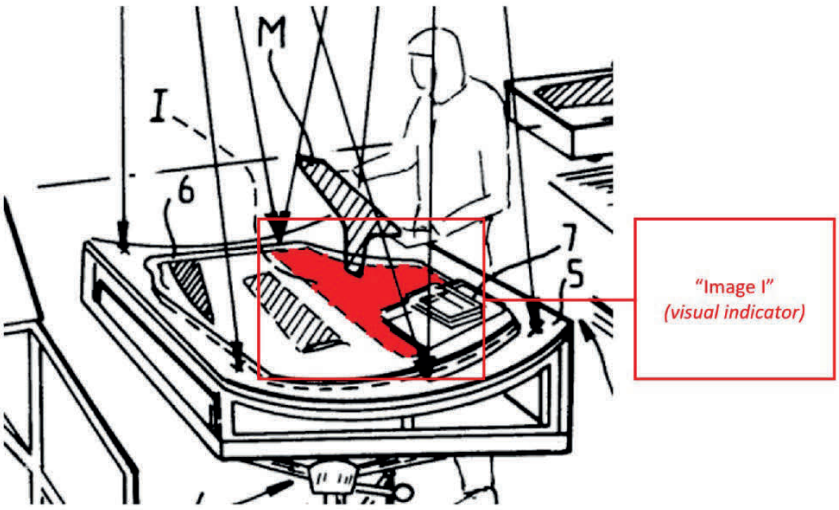
Poggi, Fig. 1 – Annotated.

Furthermore, Poggi describes projecting images to guide individuals through a sequence of assembly actions:

90. The apparatus according to the described invention comprises, in addition to the molding tooling, a video image projection system directed towards this tooling and a control system capable of having the image projection system ***project the images that indicate the exact locations where the layers must be successively deposited*** with, if necessary, additional schematic indications to facilitate their ***placement by the operator***. [Poggi at 1:50-57; *see also* Poggi, Abstract, 1:1-3, 3:31-39, Fig. 1.]

91. Thus, Poggi's overall system is an *operational guide system*, and its projectors provide *visual indicators to an individual to guide sequential actions* (i.e., "successively deposit[ing]" composite layers "by the operator.") [Poggi, 1:50-57.]

92. The *visual indicator* (projected image I) is further highlighted in the annotated figure below:



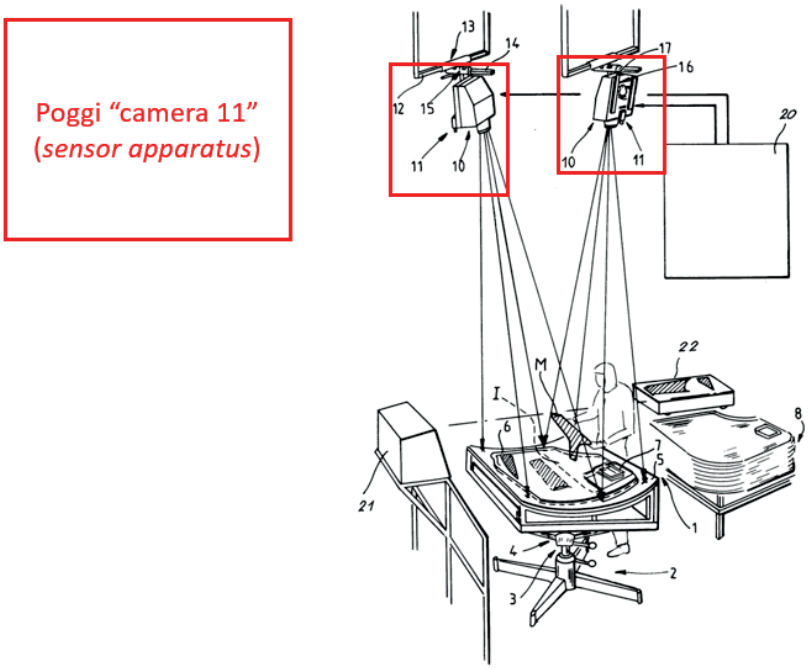
Poggi, Fig. 1 – Annotated.

93. Accordingly, Poggi discloses claim element 1.0.

> **[1.1]: "at least one sensor apparatus, said at least one sensor apparatus operable to detect operation information and generate an output indicative of said operation information;"**

94. The combination of Poggi and SIMATIC discloses *at least one sensor apparatus, said at least one sensor apparatus operable to detect operation information and generate an output indicative of said operation information*.

95. First, Poggi teaches *at least one sensor apparatus* including camera sensors. [Poggi, 3:4-5 ("The apparatus includes a projector 10 of video images and a camera 11 attached to the projector 10"); *see also* Poggi, Abstract, 2:7-10, 3:17-18, 3:39-49, 4:17-21, 5:48-51 (Claim 1), 6:5-13 (Claims 3-4).] Poggi's cameras are highlighted in the annotated version of Figure 1 provided below.



Poggi, Fig. 1 – Annotated.

Poggi also discloses that its computer 20 is "able to compare the images from the camera with the reference images of the layers." *Id*., 2:11-12. Computer 20 then prevents the display of a new image until any problems are addressed. *Id*., 4:7-12 (explaining that if an error is found, "operation of the projectors 10 is blocked until the error is corrected.") Poggi thus

discloses a *sensor apparatus operable to detect operation information and generate an output indicative of said operation information*.

96. In the combined system of Poggi-SIMATIC, cameras 11 in Poggi are replaced with the Vision Sensor in SIMATIC. This vision sensor contains both imaging and machine vision functionality and satisfies the claim limitation of *at least one sensor apparatus*. ['981 Patent, 5:53-56 ("a sensor apparatus may comprise a vision system configured to detect an identifiable characteristic or identification information associated with a work piece.")]

97. Second, the combination of Poggi and SIMATIC discloses the *sensor apparatus* is *operable to detect operation information*. The '981 patent discloses "operation information … such as, for example, the presence of and/or the type of work piece 14 present at the work station." ['981 patent, 4:38-43; *see also* '981 patent, 5:35-38.] Poggi describes that cameras 11 are *operable to detect operation information* by detecting at least the shape and position of the layers, which includes detecting the presence of a workpiece. [Poggi, 2:7-10 ("a camera … able to discern the texture, the ***shape and position*** of the layers actually placed on the tooling.") (emphasis added); *see also* 3:53-54, 3:57-59.]

98. Meanwhile, SIMATIC discloses *detect[ing] operation information* by detecting the presence of a work piece by recognizing visual features in the

images. [SIMATIC, 61 ("Presence/Absence SoftSensors perform basic checks for detection of features."); *see also* SIMATIC, 115.] For example, SIMATIC discloses FeatureCount SoftSensors "designed to detect and count features that make the part being inspected different from the background." [SIMATIC, 64.] "For example, a transition from bright to dark, followed by a transition from dark to bright indicates the presence of a dark object in bright background. That object is considered a dark feature. Likewise, a light feature is defined by a transition from dark to bright followed by a transition from bright to dark." [SIMATIC, 64.] As another example, SIMATIC detects the presence of a work piece by detecting its shape or position. One of the ways to do so involves identifying "connected pixels of similar intensity," or "blobs," within the camera images. [SIMATIC, 91-93.] "The blob generator analyzes the image and isolates the blobs based on user options (threshold level and type[s] of blob to locate)." [SIMATIC, 91.] The positions of individual blobs are, therefore, calculated and can even be tracked as the part moves within the camera's frame of view. [SIMATIC, 91; SIMATIC, 112-114 ("Dealing with Part Movement.")]

99. SIMATIC also discloses its sensing system can *detect operation information* by detecting the type of a work piece, such as by matching the pixel pattern of a part against learned references. As described above in Section XI.A.1,

Template Match SoftSensor in SIMATIC "learns the pixel pattern contained in the rectangle … and compares the subsequent images to the learned one." [SIMATIC, 94; SIMATIC, 94-96.] As shown below, SIMATIC Figure 3-28 illustrates such a detection process.

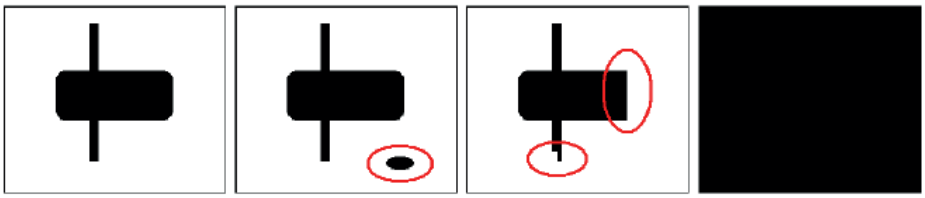


Figure 3-28: Sample images that illustrate the use of only dark pixels for the inspection.

SIMATIC, Fig. 3-28.

"[T]his SoftSensor can be set to pass or fail based on the amount of error, being the number of pixels or a percentage of the total pixels." [SIMATIC, 95.] A POSITA would, therefore, understand that different templates may be used to specify different types of work pieces. Thus, Template Match is operative to identify a type of the work piece by identifying whether the present part matches a template. As shown below, SIMATIC Figure 3-29 illustrates available options for template matching.

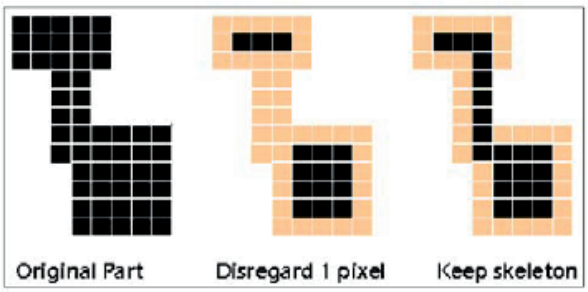


Figure 3-29: Use of the keep skeleton feature to overcome drastic geometry changes when using the option to disregard pixels near the edge.

SIMATIC, Fig. 3-29.

100. Similarly, SIMATIC also teaches an ObjectFind SoftSensor that "learn[s] the characteristics of an object and find[s] occurrences of that object in subsequent images." [SIMATIC,97; SIMATIC, 97-99.] Given this teaching, a POSITA would understand each object to be found corresponds to a "type" of a work piece, and SIMATIC discloses detecting at least a type of the work piece by determining whether or not a detected shape matches this object. As shown below in SIMATIC Figure 3-31, SIMATIC can detect objects that are both translated and rotated.

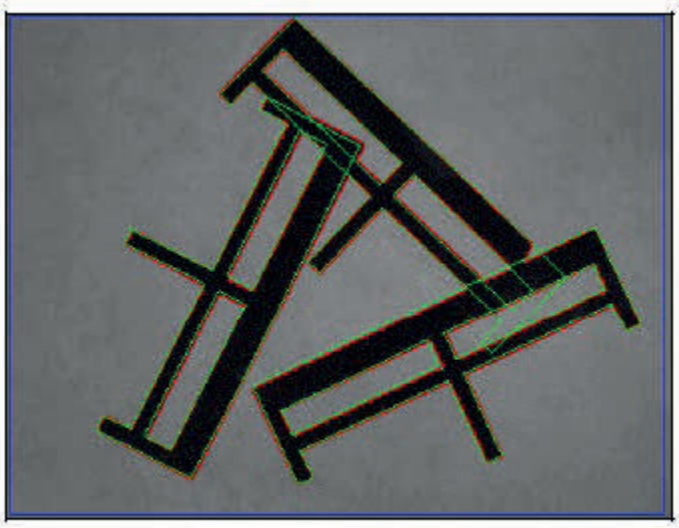


Figure 3-31: Image marking for the ObjectFind SoftSensor

SIMATIC, Fig. 3-31.

101. Notably, SIMATIC discloses that SoftSensors such as TemplateMatch or Object find can be used for part identification (which identifies *operation information* because it identifies the part *type*).

> Identifying a part is a very broad type of application which generally entails defining differences between the parts and identifying them using SoftSensors. There are several different techniques for achieving part identification and they depend mostly on the part being inspected. They can be implemented using one or many different SoftSensors to detect the differences between parts. Some SoftSensors which can be used by themselves to identify parts are Blob, ObjectFind, Color (PixelCounting), Reader, Segmentation, and TemplateMatch SoftSensors.

[SIMATIC at 121.]

102. The combination of Poggi and SIMATIC teaches the *sensor apparatus ... generat[*es*] an output indicative of said operation information*. Poggi's cameras 11 and computer 20 are electrically connected so that information may be transmitted from the cameras 11 to computer 20. [*See* Poggi, 3:24-26; *see also* 2:11-12.] First, cameras 11 transmit an output to computer/controller 20 including pictures of the laid-up composite layers on the work station. [Poggi at 3:41-48 ("when the computer 20 is told that we will move on to the next step, the image collected by the cameras 11 is examined by the computer 20 and compared to the image that should be found."); *see* Poggi, 2:11-15 ("***a computer*** such as a microcomputer to which the camera is connected and which is able to ***compare the images***

from the camera with the reference images of the layers it has in memory …") (emphasis added); Poggi, 5:48-56(Claim 1).] Second, the cameras 11 further transmit to computer 20 the discerned shape and position of the last layer placed on the tooling. [*See* Poggi, 2:7-10.]

103. Similarly to the Poggi cameras, SIMATIC discloses *generating an output indicative of said operation information*. "[W]hen the Vision Sensor is inspecting the images, it sends out the user defined outputs indicating the result of the inspection." [SIMATIC, 29; *see also* SIMATIC, 123 ("Synchronous transfers of data happen after every inspection. The user sets up the data to be transferred and that data is sent out after every inspection. This ensures the receiving system that new data is transferred as soon as it becomes available.")] "This information might be as generalized as a PASS or FAIL signal or as specific as position feedback to a motion controller." [SIMATIC, 13; *see also* SIMATIC, 33.] Section 5 of SIMATIC detailed "the different ways in which the user can send data to the Vision Sensor or get data out of it." [SIMATIC, 123; SIMATIC, 123-129.] The generated output is further indicative of the detected operation information; "***[d]epending on the output from every SoftSensor***, one of the selected messages (Strings) will be sent out or, in some cases, no string will be sent out … The fact that every string is fully configurable gives the user the

flexibility needed to implement an effective inspection." [SIMATIC, 125 (emphasis added).]

104. For example, the Template Match SoftSensor tool in SIMATIC compares detected pixel patterns (*i.e.*, shapes) in the image of a work piece against a learned template. "[T]his SoftSensor can be set to pass or fail based on the amount of error, being the number of pixels or a percentage of the total pixels." [SIMATIC, 95.] Subsequently, SIMATIC may send out a custom string in response to the pass/fail condition of the Template Match SoftSensor. As shown below in Figure 5-1, SIMATIC has the ability to send out an array of data from its sensing system based on different combinations of pass/fail conditions.

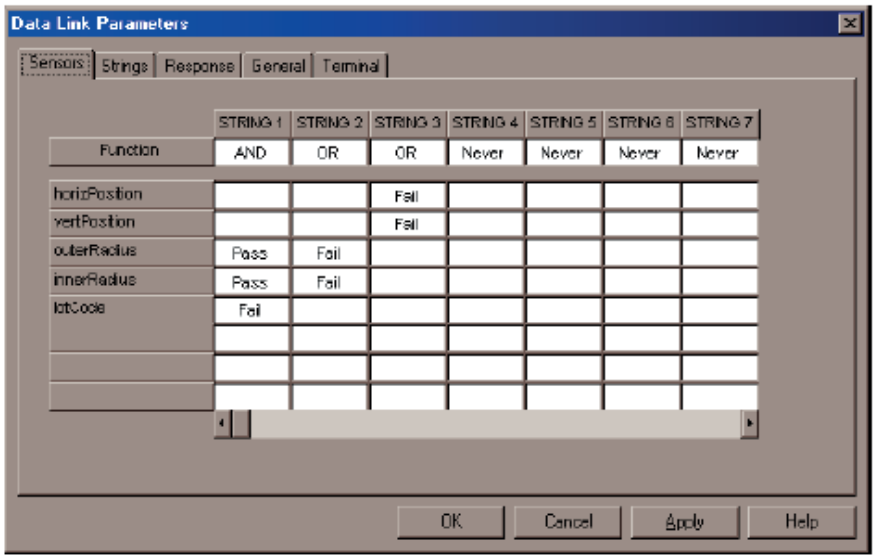


Figure 5-1: Screen capture of DataLink. In this case three different messages are requested from the system based on the inspection results

SIMATIC, Fig. 5-1.

105. In addition, a user can configure the output string to include parameter values of a SoftSensor object other than simply binary pass/fail results. For example, in Figure 5-2, reproduced below for convenience, "[t]he string was setup using text ('The lot code read was: ') then a reference to the SoftSensor that contains the information to be sent out (in this case lotCode is the SoftSensor and its string is what contains the data, so 'lotCode.String' will reference the desired data)." [SIMATIC, 125.] A POSITA would, therefore, understand SIMATIC discloses that outputting other information indicative of operation information can also be part of the output string.

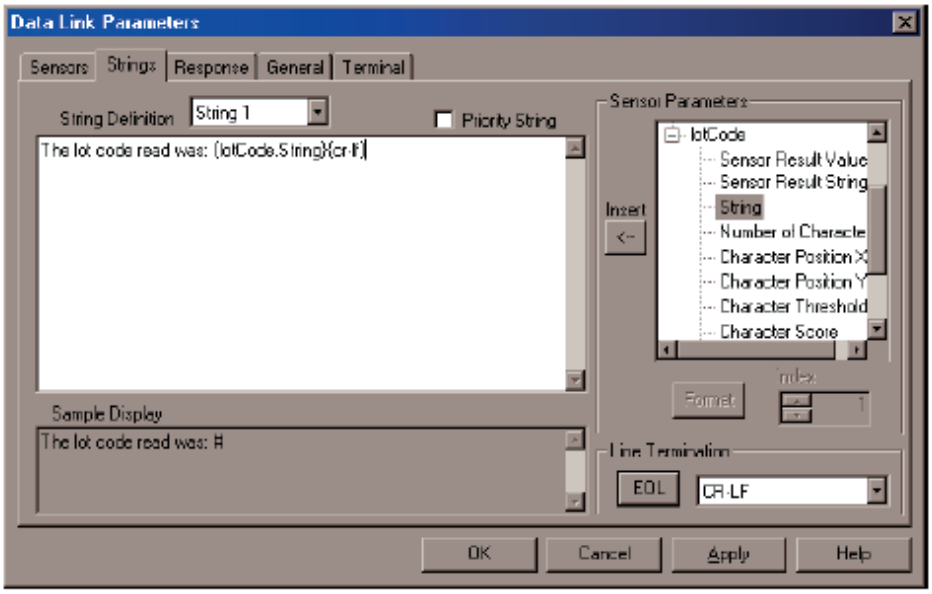


Figure 5-2: String setup for DataLink

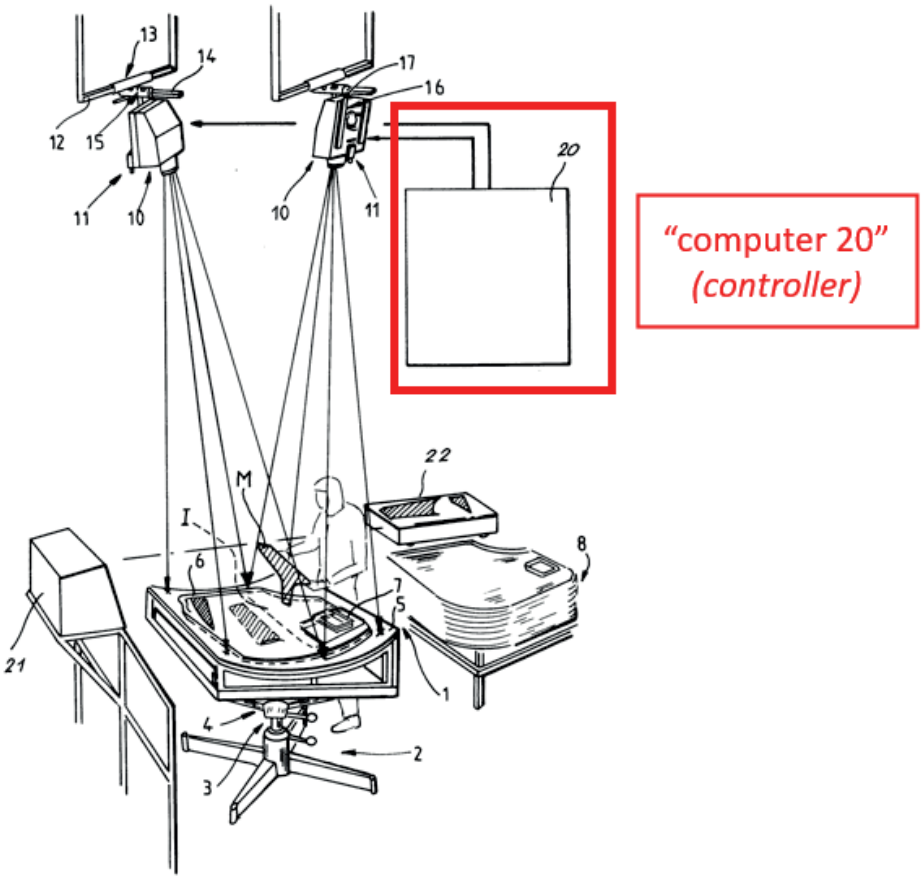
SIMATIC, Fig. 5-2.

106. Accordingly, the combination of Poggi and SIMATIC discloses claim element 1.1.

[1.2]: "a controller, said controller receiving at least a first input signal indicative of said operation information and selectively providing at least one command signal in response to said first input signal; and"

107. The combination of Poggi and SIMATIC discloses *a controller, said controller receiving at least a first input signal indicative of said operation information and selectively providing at least one command signal in response to said first input signal*.

108. First, Poggi discloses a computer 20 connected to both the camera 11 and the projector 10, as shown in the annotated version of Figure 1 provided below. This computer 20 comprises the claimed *controller*.



Poggi, Fig. 1 – Annotated.

109. Second, the combination of Poggi and SIMATIC teaches *said controller receiving at least a first input signal indicative of said operation information*. In a combined Poggi-SIMATIC system, the SIMATIC Vision Sensor substitutes in and performs the role of Poggi's camera 11. As discussed above in [1.1], the SIMATIC Vision Sensor detects operation information and generates an output indicative of said operation information. Poggi explains that computer 20 is a "microcomputer to which the camera is connected and which is able to compare the images from the camera with the

reference images of the layers it has in memory." [Poggi, 2:11-15; *see also* analysis above [1.1].] Poggi also describes computer 20 comparing the detected position and shape information of the top layer with that of reference images. [Poggi, 3:53-59.] Thus, in the combined system of Poggi-SIMATIC, computer 20 receives *a first input signal* including the output from the SIMATIC Vision Sensor. This *first input signal* is, therefore, also *indicative of [the] operation information*.

110. Third, Poggi's computer 20 *selectively provid[es] at least one command signal in response to said first input signal* when it instructs the projector to display an image. [*See* Poggi, 3:31-34 ("The computer 20 then controls the projectors 10 so that an image (I in Figure 1) of the layer to be placed at that time is projected on the correct location on the tooling 1"); *see also* Poggi, 1:52-57 ("a control system capable of having the image projection system project the images that indicate the exact locations where the layers must be successively deposited"); Poggi, 5:39-44 (Claim 1).]

111. These instructions are *selectively provided … in response to said first input signal* because the computer 20 permits the next image to be displayed only when it determines that the previous step was properly performed, using the *first input signal* received from the camera. Poggi describes this process as follows:

> "[W]hen the computer 20 is told that we will move on to the next step, the image collected by the cameras 11 is examined by the computer 20 and compared to the image that should be found.
>
> [F]irst . . .the shape of the layer that has just been placed is recognized and compared to the shape of the layer to be deposited.
>
> If the comparison is positive, the computer 20 compares, by their coordinates on the image, the location where the layer is placed in the intended location.
>
> …
>
> If no errors are found, the computer 20 projects the image of the next layer when the operator requests it. Otherwise, an error message is displayed on the graphic consoles 21 based on the results of the various comparisons, and the operation of the projectors 10 is blocked until the error is corrected."

[Poggi, 3:41-4:12; *see also* Poggi, 1:58-60, 5:52-58 (Claim 1).] Notably, the '981 patent discloses that "command signals 44, 50 being communicated based on, at least in part, the first input signal 42." ['981 patent at 6:62-63.] This is exactly the disclosure of Poggi, in that a command signal to project a

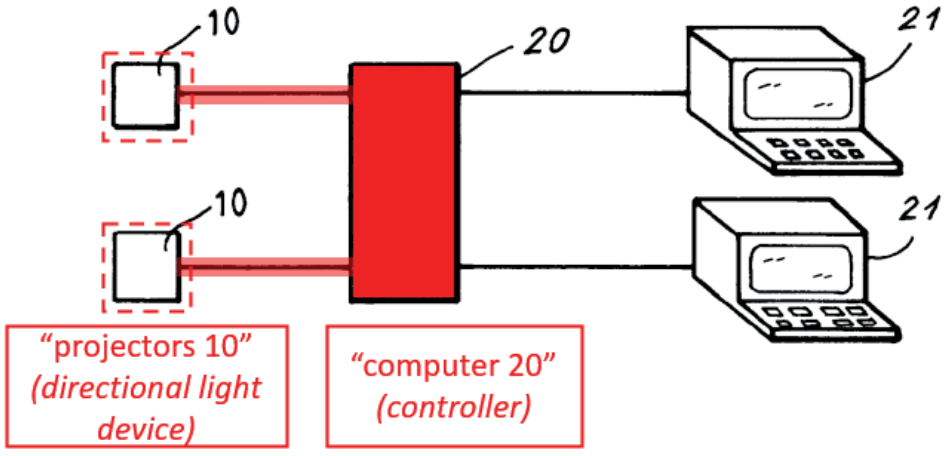
new image is provided in part based on the operator request and in part on the outcome of the image analysis (i.e., the *input signal* from [1.1]).

112. When Poggi's computer 20 permits the projectors to display the next image, it performs the step of *providing at least one command signal* to the projector. Poggi explains that the computer 20 and the projector 10 are electrically connected:

> **The apparatus control system consists essentially of a computer 20** connected by power lines to the projectors 10 and cameras 11 as well as graphic consoles 21.

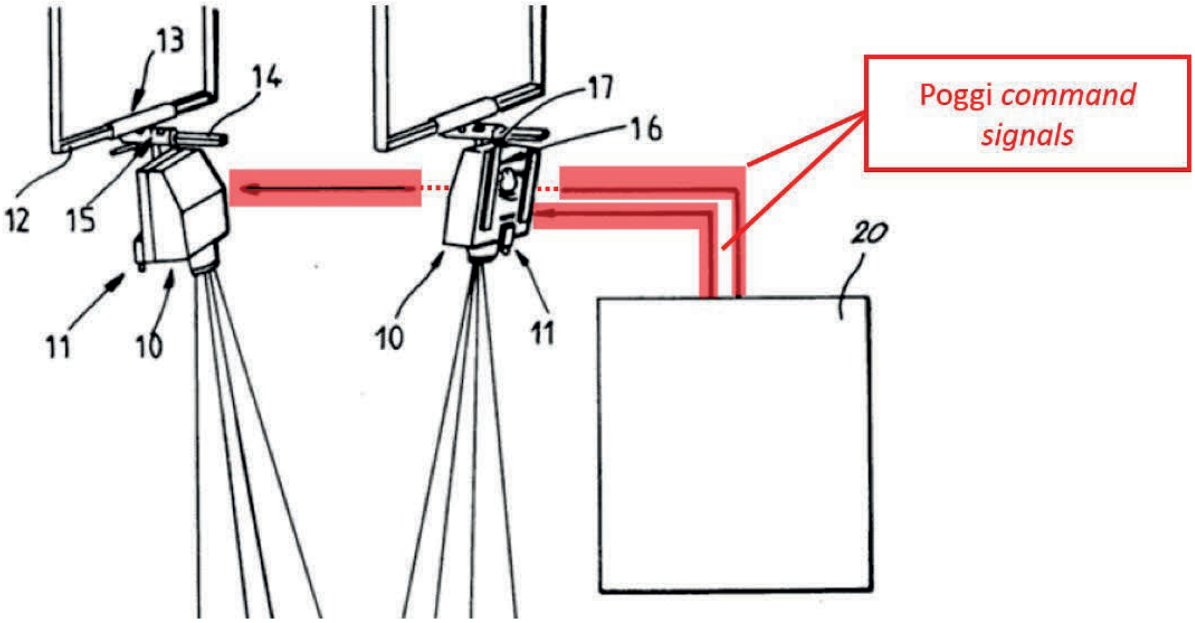
[Poggi, 3:24-27 (emphasis added).]

113. Poggi Figure 2 illustrates this eletrical connection, as shown in the annotated version provided below.



Poggi, Fig. 2 – Annotated.

Through this electrical connection, Poggi's computer 20 sends *command signals* telling the projectors what to display, as illustrated by the arrows in the annotated version of Poggi Figure 1 provided below.



Poggi, Fig.1 – Annotated.

114. A POSITA viewing this image and considering the electrical connection between computer 20 and the projector would understand that Poggi discloses that its *controller* (computer 20) sends *at least one command signal* to the projector when it states that "computer 20 projects the image of the next layer when the operator requests it." [Poggi, 4:7-8.] Sending a command signal through an existing electrical connection presents a straight-forward solution compared to other methods of transmission. Doing so is also well within a POSITA's knowledge and skill. That Poggi's

computer 20 controls the images displayed by the projector is also confirmed by other passages in the disclosure. [Poggi, 3:31-34 ("The computer 20 then controls the projectors 10 so that an image (I in Figure 1) of the layer to be placed at that time is projected on the correct location on the tooling 1."); Poggi, 1:53-57 ("control system capable of having the image projection system project the images that indicate the exact locations where the layers must be successively deposited with, if necessary, additional schematic indications to facilitate their placement by the operator"); Poggi, 5:40-44 (Claim 1) ("a control system (20) capable of having the projectors (10) project images indicating the shape, location and texture of the layers to be deposited successively by the operator.").]

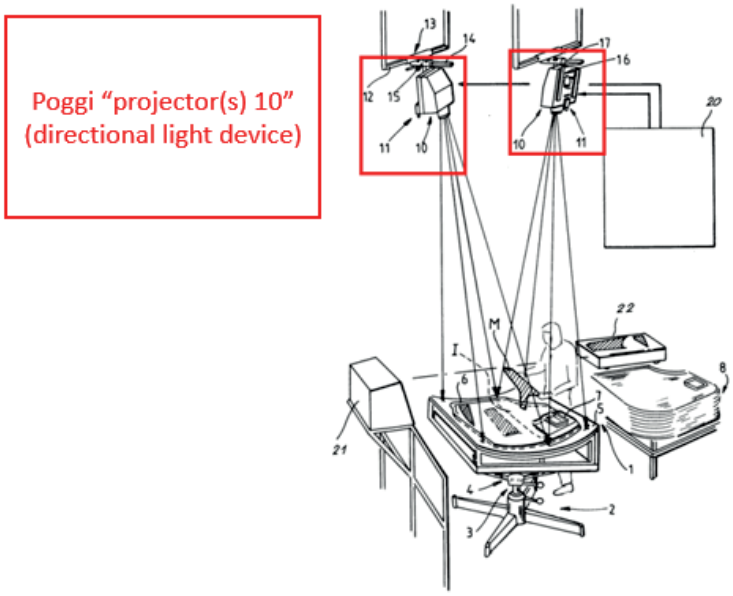
115. By succinctly combining the disclosures in Poggi discussed above, Poggi teaches that computer 20 (*controller*) receives a *first input signal* (including camera images and shape and position information of the last placed layer) *indicative of said operation information*. Subsequently, computer 20 compares the camera images with reference images to determine whether to permit projectors 10 to display the next layer in the assembly process. If the images are a match, then computer 20 *provides at least one command signal in response to said first input signal*, by instructing the projector to project the image of the next layer in the sequential assembly process.

116. Accordingly, Poggi-SIMATIC discloses and renders obvious claim element 1.2.

> **[1.3]: "at least one directional light device, said at least one directional light device selectively operable to project and target at least one indicating light in response to said at least one command signal from said controller."**

117. Poggi discloses *at least one directional light device, said at least one directional light device selectively operable to project and target at least one indicating light in response to said at least one command signal from said controller*.

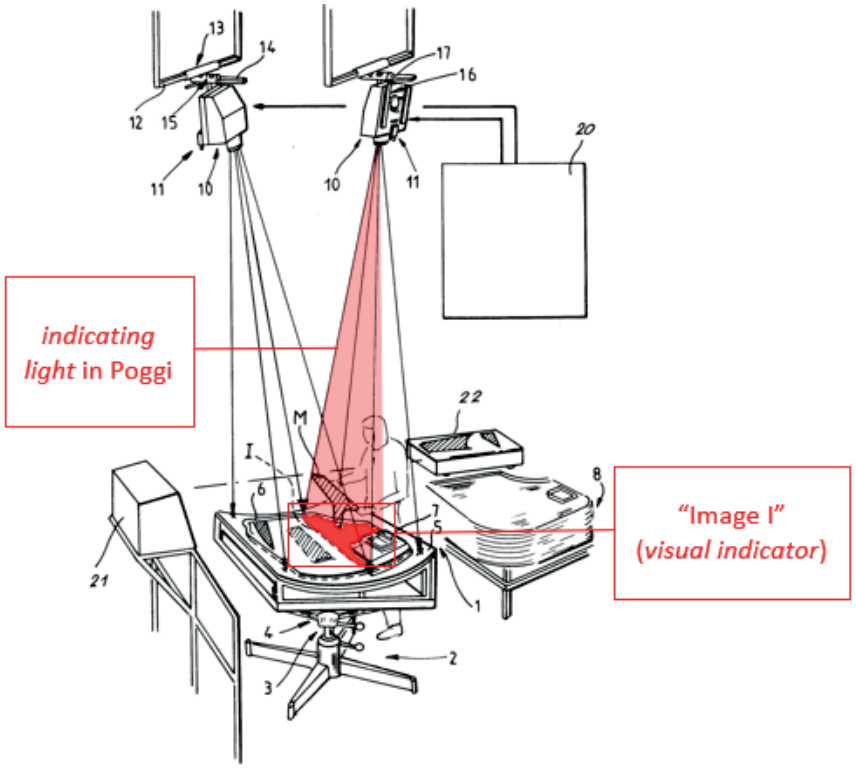
118. First, the projectors 10, shown in the annotated version of Figure 1 provided below, are the *at least one directional light device*.



Poggi, Fig. 1 - Annotated.

[*See also* Poggi at 1:50-57, 3:4-18, 3:24-35, 5:39-44 (Claim 1).]

119. Second, the projectors 10 are further *selectively operable to project and target at least one indicating light.* Specifically, Poggi teaches that projectors 10 project images "[to] indicate to the operator the nature **and location** of the cutouts to be successively placed." [Poggi, Abstract (emphasis added); *see also* Poggi, 1:50-57, 3:31-39, 5:39-44.] This is further illustrated in the annotated version of Poggi Figure 1 provided below, which shows an image "I" projected from an *indicating light*:



Poggi, Fig. 1 - Annotated.

Because projectors 10 direct images to locations where the next ply should be laid, Poggi teaches a *directional light device* [being] *selectively operable to project and target at least one indicating light*. [Poggi, 1:52-55 ("the

image projection system project the images that indicate the exact locations where the layers must be successively deposited"); *see also* Poggi, 3:31-39.]

120. Third, Poggi teaches projectors 10 are operable to project images onto a tooling piece *in response to said at least one command signal from said controller* (i.e. command signal from computer 20 instructing projector 10 to project the image of the next layer in the assembly). [*See, e.g.*, Poggi at 1:52-55 ("a control system capable of having the image projection system project the images that indicate the exact locations where the layers must be successively deposited"); Poggi, 3:31-35 ("The computer 20 then controls the projectors 10 so that an image (I in Figure 1) of the layer to be placed at that time is projected on the correct location on the tooling 1"); Poggi, 5:39-44 (Claim 1) (same); *see also* analysis above [1.2].]

121. Accordingly, Poggi discloses claim element [1.3] and the combination of Poggi and SIMATIC renders obvious claim 1.

3. Claim 2 Analysis

[2.0]: "The operational guide system of claim 1,"

122. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 1. [*See* analysis above [1.0] – [1.3].]

[2.1]: "wherein said at least one indicating light is provided to an operator performing an assembly action at a work station."

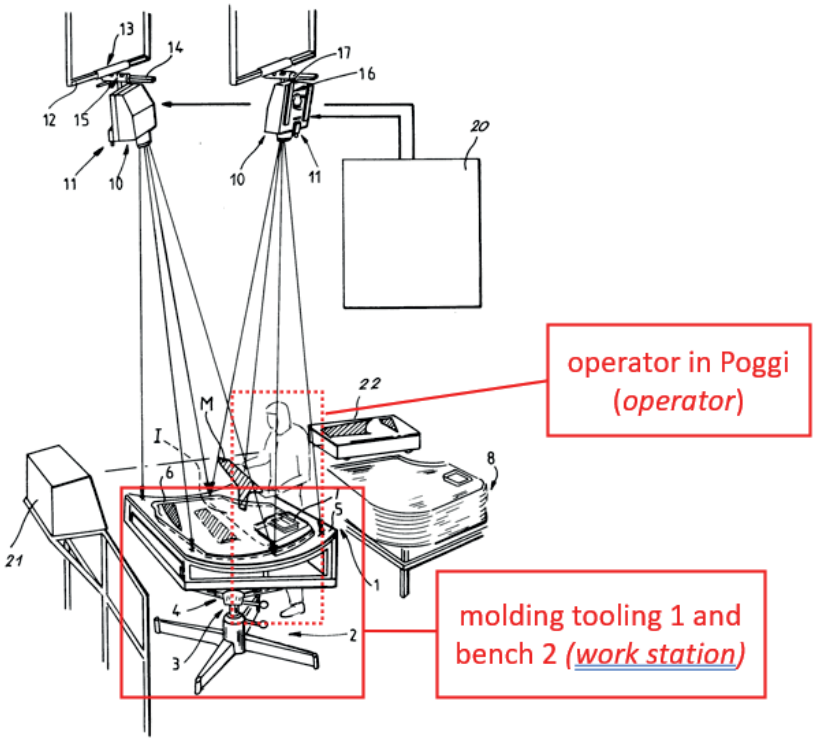
123. Poggi discloses said *at least one indicating light is provided to an operator performing an assembly action at a work station*.

124. First, as shown above in the claim 1 analysis, Poggi teaches providing *at least one indicating light* to *an operator*:

> "Apparatus for laying up a part … wherein the written list of instructions describing the manufacturing steps are replaced by ***projections of images*** on the tooling that ***indicate to the operator*** the nature and location of the cutouts to be successively placed."

[Poggi at Abstract (emphasis added); Poggi, 1:50-57, 3:31-39, 5:39-44; *see also* analysis above [1.3].]

125. Second, Poggi teaches said operator is *performing an assembly action at a work station* that includes tooling 1 and work bench 2, as shown below in the annotated version of Poggi Figure 1.



Poggi, Fig. 1 - Annotated.

126. Specifically, the operator in Poggi performs *an assembly action* by depositing ("laying up") successive composite layers onto tooling 1 to produce composite parts and/or panels:

> "Apparatus for laying up a part through the ***assembling of cut fabric or strips of fibers*** pre-impregnated with resin onto a molding tooling (1), wherein the written list of instructions describing the manufacturing steps are replaced by projections of images on the tooling that indicate to the operator the nature and location of the cutouts to be successively placed. ...
> Application to the manufacture of composite material parts and panels."

[Poggi at Abstract; *see also* 1:1-15, 1:25-43; 1:49-57; 3:30-39; 5:39-44; *see also* Figure 1.]

127. Accordingly, Poggi discloses claim element [2.1] and the combination of Poggi and SIMATIC renders obvious claim 2.

4. Claim 4 Analysis

[4.0]: "The operation guide system of claim 2,"

128. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 2. [*See* analysis above [2.0] – [2.1].]

[4.1]: "wherein said operation information comprises identification of a presence of a work piece at said work station."

129. The combination of Poggi and SIMATIC discloses *said operation information comprises identification of a presence of a work piece at said work station*.

130. First, *work piece[s]* in Poggi are layer(s) of composite materials deposited on the molding tooling (*i.e.*, an unfinished composite part or a finished part on said tooling). [*See, e.g.*, Poggi at Abstract ("Apparatus for laying up a part through the assembling of cut fabric or strips of fibers pre-impregnated with resin onto a molding tooling (1)"); Poggi, 1:4-9 ("The lay-up technique involves building the structure of parts such as hull or panel elements, by assembling fabric cutouts or high strength fiber strips … on the surface of a

molding tooling").] Each *work piece* is located at the *work station*, where molding tooling 1 and its supporting work bench 2 are located. [*See* analysis above [2.1].]

131. Second, as discussed above in [1.1], the SIMATIC Vision Sensor detects the *presence of a work piece* by identifying the presence of a work piece, such as by detecting visual features that distinguishes a work piece from its background, or by detecting the shape and position of a work piece in camera images.

132. Accordingly, the combination of Poggi and SIMATIC discloses claim element [4.1] and renders obvious claim 4.

5. Claim 5 Analysis

[5.0]: "The operational guide system of claim 4,"

133. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 4. [*See* analysis above [4.0] – [4.1].]

[5.1]: "wherein said operation information comprises identification of a type of the work piece at said work station, and wherein said at least one command signal is selectively provided depending on the type of the work piece identified."

134. The combination of Poggi and SIMATIC discloses *wherein said operation information comprises identification of a type of the work piece at said work station, and wherein said at least one command signal is selectively provided depending on the type of the work piece identified*.

135. As discussed above for [1.1] – [1.2] and claim 4, in the Poggi-SIMATIC combination, SIMATIC teaches using the SIMATIC vision sensor to evaluate the placement of each fabric layer (instead of using computer 20 in Poggi to compare camera images with reference images). To do so, the SIMATIC vision sensor detects *operation information compris[ing] identification of a type of the work piece at said work station.* [See analysis above at [1.1].]

136. For example, SIMATIC discloses using the Template Match SoftSensor to implement defect detection of parts. [SIMATIC, 94.] Specifically, Template Match SoftSensor uses the pixel pattern contained in a first image as a template that subsequent images are compared against and returns an error when the amount of error exceeds a custom threshold. [*See* analysis above at [1.1].] It would have thus been obvious to a POSITA that the reference images in Poggi can be used to specify the templates in a combined Poggi-SIMATIC system, and each of the reference image represents *a type of the work piece* to be detected. [*See also* Section XI.A.1.]

137. Meanwhile, Poggi's computer 20 sends command signals to projectors 10 based on a result of the Template Match. [*See* analysis above at [1.1], [1.2]]. "If no errors are found, the computer 20 projects the image of the next layer

when the operator requests it. Otherwise, an error message is displayed on the graphic consoles 21 based on the results of the various comparisons, and the operation of the projectors 10 is blocked until the error is corrected." [Poggi 4:6-12.] Thus, the controller in Poggi selectively provides command signals depending on the type of the work piece identified because it blocks the operation of projectors 10 if the camera image and reference image cannot be matched and vice versa.

138. Accordingly, the combination of Poggi and SIMATIC discloses claim element [5.1] and renders obvious claim 5.

6. Claim 6 Analysis

[6.0]: "The operational guide system of claim 2,"

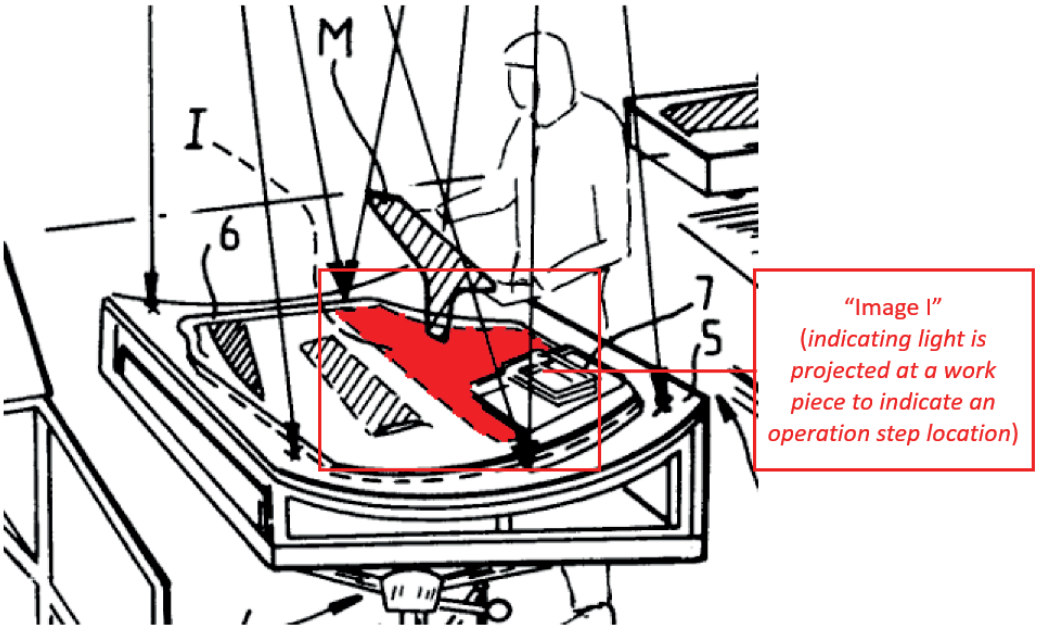
139. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 2. [*See* analysis above [2.0] – [2.1].]

[6.1]: "wherein said at least one indicating light is projected at a work piece to indicate an operation step location."

140. Poggi discloses *said at least one indicating light is projected at a work piece to indicate an operation step location*.

141. Poggi states that its "image projection system project[s] the images that indicate the exact locations where the layers must be successively deposited…" [Poggi, 1:53-56; *see also* Poggi, Abstract, 3:31-39, 5:39-44.] These projected images are projected by shining at least one indicating light

from the Poggi projectors. [*See* Poggi, Fig. 1.] Poggi further teaches projecting said indicating light at *a work piece* because the layers forming the work piece at least "partially overlap," [Poggi, 1:6-9; *see also* Poggi, 1:9-11 (describing "bind[ing] the composite layers" in a manner that requires overlapping regions,)] meaning the light is directed towards the *work piece* (the laid up pile of layers on tooling 1) and not just individual layers. Such a projection is illustrated in the annotated version of Poggi Figure 1 provided below.



Poggi, Fig. 1 - Annotated.

Accordingly, Poggi discloses claim element [6.1] and the combination of Poggi and SIMATIC renders obvious claim 6.

7. Claim 7 Analysis

[7.0]: "The operational guide system of claim 1,"

142. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 1. [*See* analysis above [1.0] – [1.3].]

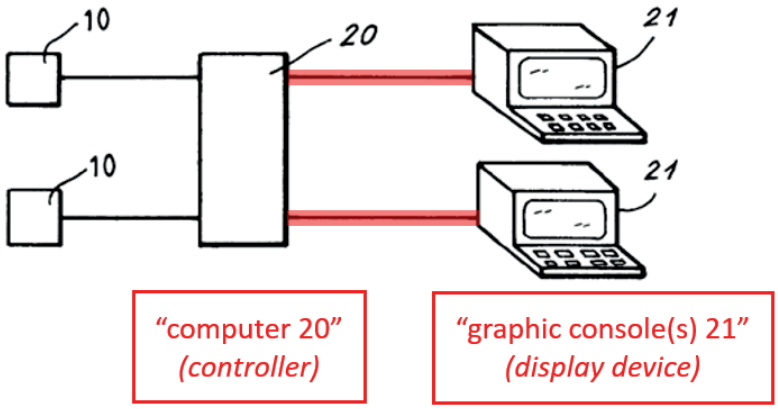
[7.1]: "wherein said controller is adapted to receive at least one confirmation signal indicative of a completion of an assembly action, said at least one confirmation signal comprising at least one signal selected from the group consisting of a manually input signal and an automated input signal."

143. Poggi discloses *said controller is adapted to receive at least one confirmation signal indicative of a completion of an assembly action, said at least one confirmation signal comprising at least one signal selected from the group consisting of a manually input signal and an automated input signal*.

144. Poggi discloses the *controller receiving* more than one *confirmation signal indicative of a completion of an assembly action.* Specifically, *assembly actions* are completed when the "appropriate layer (M) is … placed by the operator so that it overlaps with the projected image." [Poggi at 3:37-39.] Afterwards, computer 20 receives a manual request from the operator to "move on to the next step." [Poggi, 3:41-42; *see also* Poggi, 4:7-8.] Thus, *controller* (computer 20) receives a *confirmation signal indicative of a completion of an assembly action* in the form of an operator instruction to

"move on to the next step" following placement of the "appropriate layer (M)." [Poggi at 3:38-42.]

145. Poggi describes the *confirmation signal* as being a *manually input signal* by the operator. Specifically, Poggi teaches "[b]efore placing a layer, the operator signals it by typing an instruction on a graphic console 21." [Poggi, 3:30-31; *see also* Poggi, 4:7-8 ("the computer 20 projects the image of the next layer when the operator requests it.").] As illustrated in the annotated version of Figure 2 provided below, computer 20 and graphic console(s) 21 are electrically connected such that the manual input signal can be transmitted to computer 20.



Poggi, Fig. 2 - Annotated.

Accordingly, Poggi discloses claim element [7.1] and the combination of Poggi and SIMATIC renders obvious claim 7.

8. Claim 11 Analysis

[11.0]: "The operational guide system of claim 1,"

146. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 1. [*See* analysis above [1.0] – [1.3].]

[11.1]: "wherein said controller is configured to monitor operational information associated with sequential actions."

147. Poggi discloses *said controller is configured to monitor operational information associated with sequential actions*.

148. The term "operational information" is not used in the specification, and I understand that Amazon has taken the position in related district court litigation that the term is indefinite. Nevertheless, claim 12 of the '981 patent demonstrates that "operational information" includes at least "an incorrectly performed action." ['981 patent, cl. 12.] Consistent with claim 12 of the '981 patent, Poggi discloses *wherein said controller is configured to monitor* for an incorrectly performed action among a set of *sequential actions*.

149. For example, the *controller* in Poggi (computer 20) monitors whether each of the composite layers in the composite layup sequence is laid down correctly by comparing images of the workpiece at each step to reference images. When a layer is not laid down correctly, computer 20 causes an error to be displayed on graphics console 21 and blocks projectors 10 from

operating until the error is corrected. [Poggi, 4:7-12; *see also* 1:57-2:15, 3:45-4:6.] This type of operation information is monitored throughout the sequence of assembly actions.

150. Accordingly, Poggi discloses claim element [11.1] and the combination of Poggi and SIMATIC renders obvious claim 11.

9. Claim 12 Analysis

[12.0]: "The operational guide system of claim 11,"

151. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 11. [*See* analysis above [11.0] – [11.1].]

[12.1]: "said operational information including at least one selected from the group consisting of a cycle time, an incorrectly performed action, a time between sequential actions, and an operator identification."

152. Poggi discloses *said operational information including at least one selected from the group consisting of a cycle time, an incorrectly performed action, a time between sequential actions, and an operator identification*.

153. As discussed above in [11.1], computer 20 in Poggi monitors for *an incorrectly performed action* by determining whether each of the composite layers in the composite layup sequence is laid down correctly by the operator. When a layer is not laid down correctly, "an error message is displayed on the graphic consoles 21 based on the results of the various

comparisons, and the operation of the projectors 10 is blocked until the error is corrected." [Poggi, 4:9-13.]

154. Accordingly, Poggi discloses claim element [12.1] and the combination of Poggi and SIMATIC renders obvious claim 12.

10. Claim 13 Analysis

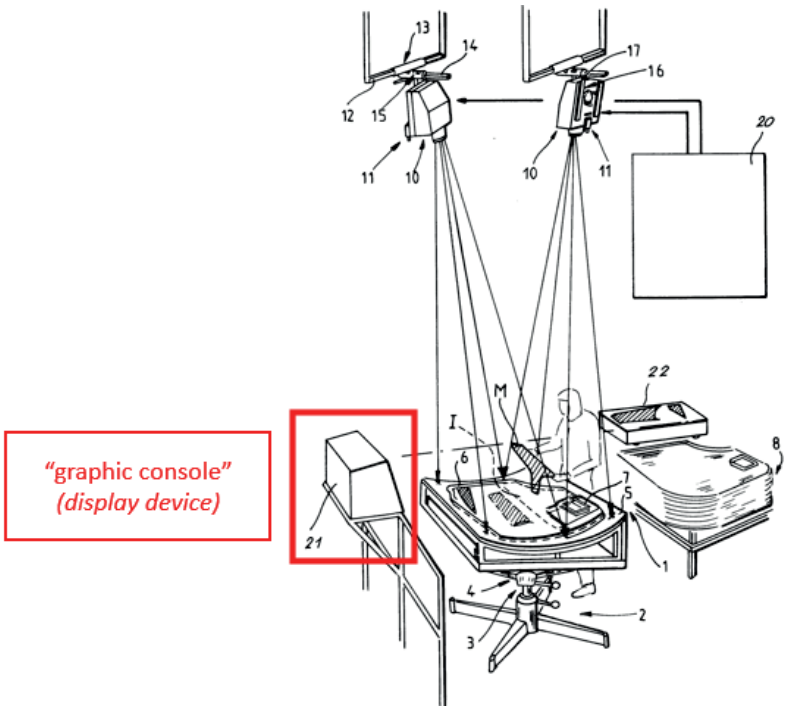
[13.0]: "The operational guide system of claim 1,"

155. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 1. [*See* analysis above [1.0] – [1.3].]

[13.1]: "further including a display device, said display device being operable to display information regarding sequential actions."

156. Poggi discloses the operational guide system *further including a display device, said display device being operable to display information regarding sequential actions*.

157. Graphic console 21 shown below in the annotated version of Poggi Figure 1 is *a display device.*



Poggi, Fig. 1 - Annotated.

[*See also* Poggi, 3:24-27, 3:30-31, 4:7-21.]

158. Graphic console 21 is further *operable to display information regarding sequential actions*. For example, graphic console 21 can be configured to display images corresponding to the location of the layers on tooling 1, or images collected by cameras 11. This is taught by Poggi in the following passage:

> "Other indications may also appear on the ***graphic consoles 21*** if the programming of the computer 20 allows it. In particular, it is possible to view ***the image on the screen of the tooling and the theoretical locations of the layers of the part***. The image collected by the cameras 11 of the lay-up actually carried out can also be

viewed, superimposed on the previous one or on another screen."

[Poggi, 4:13-20 (emphasis added).] The graphic console can also show error messages regarding improperly placed pieces. [Poggi, 4:9-12.]

159. Thus, graphic console 21 is disclosed as capable of displaying both information about each sequential action independently (*e.g.*, information about the image currently being projected), and about multiple sequential actions together (*e.g.*, the lay-up actually carried out, superimposed on the previous one).

160. Accordingly, Poggi discloses claim element [13.1] and the combination of Poggi and SIMATIC renders obvious claim 13.

11. Claim 14 Analysis

[14.0]: "A method for guiding assembly actions by providing visual indicators, said method comprising:"

161. To the extent the preamble is limiting, it is disclosed by Poggi. Specifically, Poggi discloses *a method for guiding assembly actions by providing visual indicators.*

162. As discussed above in [1.0], Poggi discloses an operational guide system adapted to provide visual indicators to an individual. Further, said operational guide system is adapted to guide assembly actions. [*See* analysis above [2.1].]

163. Accordingly, Poggi discloses claim element [14.0].

[14.1]: "identifying a characteristic of a work piece requiring assembly actions;"

164. The combination of Poggi and SIMATIC discloses *identifying a characteristic of a work piece requiring assembly actions*.

165. First, the '981 patent teaches that characteristic of a work piece includes the presence and/or type of the work piece. ['981 patent, 5:35-43 ("characteristic … associated with work piece 14, such as the presence and/or type of work piece 14 located at the work station 16.")] As discussed above in [1.1], SIMATIC teaches detecting the presence and type of a work piece. Thus, SIMATIC discloses *identifying a characteristic of a work piece* including at least the shape and position of the layers in the *work piece*.

166. Second, as discussed above in [2.1], the work piece on the work station in the combined Poggi-SIMATIC system *requir[es] assembly action* including "hand lay-up" of additional layers in the assembly. [*See, e.g.*, Abstract, 1:52-57.]

167. Accordingly, the combination of Poggi and SIMATIC discloses and renders obvious claim element [14.1].

[14.2] "communicating identification information to a controller in response to the identifying of a characteristic of the work piece;"

168. The combination of Poggi and SIMATIC discloses *communicating identification information to a controller in response to the identifying of a characteristic of the work piece*.

169. As discussed above in [14.1], the SIMATIC vision sensor performs operations that *identify a characteristic of the work piece* by detecting the presence and type of the *work piece*.

170. SIMATIC also teaches *communicating identification information ... in response* to the identifying of the characteristics above. Specifically, the '981 patent teaches that *identification information*, like characteristics of a work piece, includes "the presence and/or type of work piece." [*See, e.g.* '981 patent, 5:35-43.] The '981 patent further teaches "[t]he sensor apparatus may also be used to detect the relative orientation of a work piece with respect to the work station, with the control module adapted to receive the positional information." ['981 patent, 6:10-16.] Here, the positional information of the work piece is the *identification information.*

171. As discussed above for [1.1], SIMATIC discloses *communicating identification information ... in response to the identifying of a characteristic* by sending detected presence and type information in output strings.

SIMATIC teaches that the Vision Sensor's output strings may include SoftSensor parameters, including those specifying the presence or type of a work piece. [*See* analysis above at [1.1].] For example, SIMATIC discloses using the Blob Generator SoftSensor to detect the presence of a shape corresponding to a part on the work surface. [SIMATIC, 91-93.] A related Blob Selector SoftSensor isolates individual blob and measures parameters including its "angle," and "position," and "area." [SIMATIC, 91.] A POSITA reading these disclosures would understand that each of the parameters is *identification information* available to be sent out in an output string.

172. Lastly, the combination of Poggi and SIMATIC teaches *communicating identification information to a controller*. As discussed above in [1.2], because the SIMATIC Vision Sensor substitutes in and performs the role of Poggi's camera in a combined Poggi-SIMATIC system, SIMATIC communicates its output signals to Poggi's computer 20 (the *controller*).

173. Accordingly, the combination of Poggi and SIMATIC discloses and renders obvious claim element [14.2].

[14.3] "communicating a first command signal to at least one directional light device in response to the identifying of a characteristic;"

174. As discussed above in [1.2], Poggi discloses transmitting at least one command signal (*first command signal*) in response to receiving the shape and position of the layers.

175. Accordingly, Poggi discloses claim element [14.3].

[14.4] "selectively projecting at least one indicating light via the directional light device in response to the first command signal; and"

176. As discussed above in [1.3], Poggi discloses projectors 10 selectively operable to project indicating light in response to the command signal from computer 20 (*first command signal*). Accordingly, Poggi discloses claim element [14.4].

[14.5] "communicating a confirmation signal to the controller upon completion of a first operation step."

177. As discussed above in [7.1], Poggi discloses computer 20 receiving a confirmation signal after the operator completes each assembly action (*i.e.*, placing a composite layer on the tooling). Thus, Poggi teaches *communicating a confirmation signal to the controller* (computer 20) *upon completion of a first operation step* (placing a layer on the tooling).

178. Accordingly, Poggi discloses claim element [14.5] and the combination of Poggi and SIMATIC renders obvious claim 14.

12. Claim 15 Analysis

[15.0]: "The method of claim 14,"

179. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 14. [*See* analysis above [14.0] – [14.5].]

[15.1]: "wherein identifying a characteristic of a work piece comprises identifying the presence of a work piece with a sensor apparatus."

180. SIMATIC discloses this claim element. [*See* analysis above [14.1] – [14.2].] As discussed above in [14.1], SIMATIC discloses *identifying a characteristic of a work piece* including the presence of the work piece using the SIMATIC Vision Sensor (*with a sensor apparatus*).

181. Accordingly, SIMATIC discloses claim element [15.1] and the combination of Poggi and SIMATIC renders obvious claim 15.

13. Claim 16 Analysis

[16.0] "The method of claim 15,"

182. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 15. [*See* analysis above at [15.0] – [15.1].]

[16.1]: "including identifying the type of work piece requiring assembly actions."

183. The combination of Poggi and SIMATIC discloses this claim element. [*See* analysis above at [5.1].]

184. Accordingly, the combination of Poggi and SIMATIC discloses [16.1] and renders obvious claim 16.

14. Claim 17 Analysis

[17.0]: "The method of claim 14,"

185. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 14. [*See* analysis above [14.0] – [14.5].]

[17.1]: "wherein projecting at least one indicating light comprises projecting at least one indicating light toward at least one of a component location and an operation step location."

186. First, Poggi discloses *projecting at least one indicating light* as discussed above in [14.4]. Further, Poggi teaches projecting images at "the exact locations where the layers must be successively deposited" [Poggi, 1:53-56; *see also* Poggi, Abstract, 3:31-39, 5:39-44] using *at least one indicating light* from the projectors 10, as is discussed above in [6.1]. Therefore, Poggi discloses *projecting at least one indicating light comprises projecting at least one indicating light towards at least … an operation step location.*

187. Accordingly, Poggi discloses claim element [17.1] and the combination of Poggi and SIMATIC renders obvious claim 17.

15. Claim 19 Analysis

[19.0]: "The method of claim 14,"

188. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 14. [*See* analysis above [14.0] – [14.5].]

[19.1]: "wherein communicating a confirmation signal comprises communicating a confirmation signal from at least one selected from the group consisting of a manual input signal and an automated input signal."

189. Poggi discloses this claim element. [*See* analysis above [7.1].]

190. Accordingly, Poggi discloses claim element [19.1] and the combination of Poggi and SIMATIC renders obvious claim 19.

16. Claim 20 Analysis

[20.0]: "The method of claim 14, including: communicating a second command signal from the controller to the at least one directional light device in response to the confirmation signal;"

191. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 14. [*See* analysis above [14.0] – [14.5].]

192. Poggi teaches *communicating a second command signal from the controller to the at least one directional light device in response to the confirmation signal*.

193. As discussed above in [1.2], Poggi teaches *said controller* (computer 20) providing a first command signal instructing the projector to display an image of a layer. Furthermore, Poggi also teaches *said controller* receiving

a *confirmation signal* when the operator has finished placing a layer and wishes to proceed to the next layer. [*See* analysis above [7.1] and [14.5].]

194. In response to said *confirmation signal*, Poggi verifies the proper execution of the layer with inputs from the cameras. [*See, e.g.* Poggi, 3:39-44, 3:52-4:6.] Depending on the result, computer 20 further *communicat[es] a second command signal* to the projector to project the next image. [Poggi, 4:7-12 ("If no errors are found, the computer 20 projects the image of the next layer when the operator requests it. Otherwise … the operation of the projector[] 10 is blocked until the error is corrected.").]

195. Thus, Poggi discloses claim limitation [20.1].

[20.1]: "projecting at least one indicating light from the directional light device in response to the second command signal; and"

196. As discussed above in [1.3], Poggi discloses projectors 10 projecting and targeting indicating light in response to a command signal from computer 20. Projectors 10 project indicating light in the same way in response to the *second command signal* because the projectors' light indicates where the next part should be placed.

197. Thus, Poggi discloses claim element [20.2].

[20.2]: "communicating a confirmation signal to the controller upon completion of a second operation step."

198. Poggi discloses this claim element. [*See* analysis above [7.1].] A confirmation signal is communicated in the same way upon completion of each operation step, including *a second operation step*, such as placing an additional layer on the workpiece.

199. Accordingly, Poggi discloses claim element [20.3] and the combination of Poggi and SIMATIC renders obvious claim 20.

17. Claim 21 Analysis

[21.0]: "The method of claim 20, including:"

200. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 20. [*See* analysis above [20.0] – [20.3].]

[21.1]: "repeating said communicating a command signal; projecting at least one indicating light in response to said command signal; and communicating a confirmation signal until assembly actions for the work piece have been completed."

201. Poggi discloses *repeating said communicating a command signal; projecting at least one indicating light in response to said command signal; and communicating a confirmation signal until assembly actions for the work piece have been completed*.

202. Specifically, Poggi describes carrying out the steps described above for each layer in the assembly and verifying "***successive layers*** are correctly

deposited on ***the tooling***." [Poggi 1:58-60 (emphasis added)]. Specifically, if the placement of the current layer is correct, Poggi teaches repeating the process described in [20.0] – [21.1] for the next layer. [Poggi, 4:7-8.] Because Poggi also discloses installing a new molding tooling "***as soon as the lay-up of the current part is completed***," [Poggi, 3:1-3 (emphasis added)], a POSITA reading these disclosures would understand that Poggi discloses *repeating* operations described above in [20.0] – [21.1] until all of the layers in the assembly are placed on the current tooling, and *assembly actions for the work piece have been completed*.

203. Accordingly, Poggi discloses claim element [21.1] and the combination of Poggi and SIMATIC renders obvious claim 21.

18. Claim 23 Analysis

[23.0]: "The method of claim 14, including:"

204. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 14. [*See* analysis above [14.0] – [14.5].]

[23.1]: "monitoring operational information associated with sequential actions via the controller."

205. Poggi discloses this claim element. [*See* analysis above [11.1].]

206. Accordingly, Poggi discloses claim element [23.1] and the combination of Poggi and SIMATIC renders obvious claim 23.

19. Claim 25 Analysis

[25.0]: "The operational guide system of claim 2,"

207. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 2. [*See* analysis above [2.0] – [2.1].]

[25.1]: "further including a display device, said display device being operable to display information regarding sequential actions."

208. Poggi discloses this claim element. [*See* analysis above [13.1].]

209. Accordingly, Poggi discloses claim element [25.1] and the combination of Poggi and SIMATIC renders obvious claim 25.

B. CHALLENGE 1B: Claims 9-10, 18, 22, and 24 Are Obvious over Poggi-SIMATIC in view of Kaufman

1. Rationale for combining Poggi-SIMATIC and Kaufman

210. As discussed above in Section XI.A, the combined system of Poggi-SIMATIC uses the assembly support system in Poggi, but substitutes in the smart cameras from SIMATIC. Both Poggi-SIMATIC and Kaufman are analogous art to the '981 patent, because both systems are directed to the same field of interactive computer applications, especially those that project instructions to operators to aid them in completing a task. [*See* Poggi, Abstract, 1:50-57; Kaufman, 1:20-26] Poggi-SIMATIC and Kaufman are also reasonably pertinent to the problem to which the '981 patent was directed – guiding human operators in assembly tasks, including by

projected light. [*See, e.g.*, '981 patent at 1:16-19 ("system for guiding an individual in the performance of operational steps, and … provid[ing] visual indicators to the individual").]

211. A POSITA would have been motivated to combine Poggi-SIMATIC and Kaufman for the reasons discussed below. The same reasons further go to show that a POSITA would have had a reasonable expectation of success combining the software interfaces in Kaufman with Poggi-SIMATIC.

212. First, a POSITA would have understood controller 20 in Poggi requires a program to "teach it the shape of each tooling 1 as well as the location and shape of the various layers that must be placed on this tooling 1." Therefore, there is motivation to implement Poggi with a software interface(s) similar to that taught in Kaufman to create/modify programs using display 21. [Poggi, 3:27-30.] To the extent a POSITA does not view Poggi as disclosing programming interfaces for this step, Kaufman discloses it. The programming interfaces taught by Kaufman would make Poggi's required programming easier to perform because they allow the user to easily adjust the operational parameters of the software being used to control the system. Thus incorporating the teachings of Kaufman into Poggi-SIMATIC is nothing more than combining prior art elements (Poggi-SIMATIC and

Kaufman's parts database and program screens) according to known methods to yield predictable results.

213. Second, it would have been obvious to incorporate the software interface concepts from Kaufman into Poggi-SIMATIC, because both systems are narrowly directed to the same type of manufacturing assembly task: the sequential draping of fabric layers to create complex structures. Furthermore, as set forth above, Poggi and Kaufman both disclose systems analogous to the '981 patent. Thus, combining the concepts of Kaufman with Poggi-SIMATIC simply requires adding the type of software interfaces disclosed in Kaufman to the display screen of Poggi-SIMATIC, which a POSITA would have understood and have been motivated to do, because it would constitute improving similar devices in the same way.

214. Third, design incentives, including the need to streamline the control and configuration of manufacturing systems, would have led a POSITA to implement Poggi-SIMATIC with the types of software interfaces disclosed by Kaufman. This is the case because Kaufman and Poggi-SIMATIC are both directed to the same specific application: using lights to guide an individual in the placement of multiple layers of material onto an underlying tool to form a structure.

215. Patent Owner may argue that Poggi-SIMATIC and Kaufman are incompatible because Poggi-SIMATIC uses a video projector and Kaufman uses a laser projector. However, it is my understanding that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference, but rather whether a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention. Furthermore, the teachings Kaufman cited below are not specific to laser projectors and apply generally to ply layup systems such as Poggi-SIMATIC. Thus, a POSITA would have had a reasonable expectation that the combination would succeed.

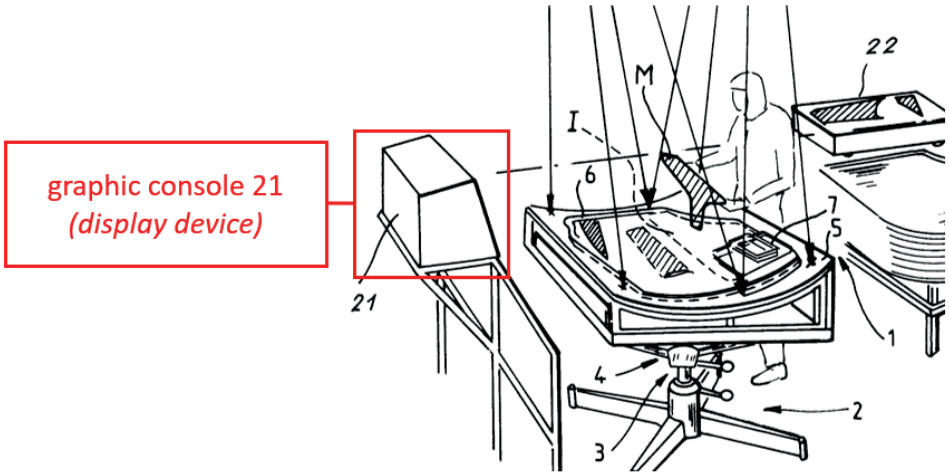
216. Kaufman's teachings regarding a system that provides one or more input fields for adding or editing part information provide a sufficient teaching for a POSITA to apply a similar technique to the similar system in Poggi-SIMATIC. Therefore, the programming interface teachings of Kaufman could be used with any type of projector.

2. Claim 9 Analysis

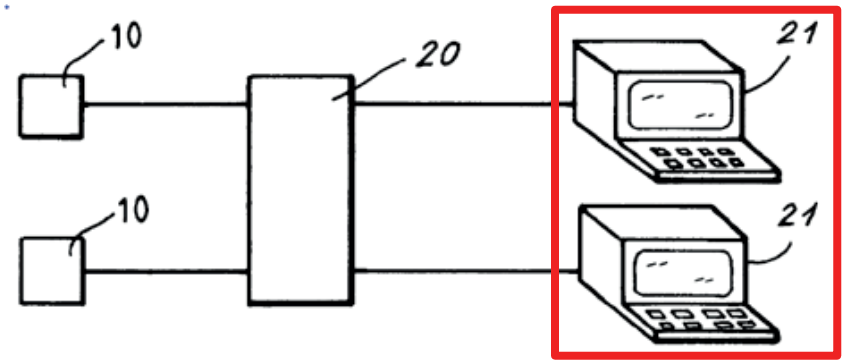
[9.0] "The operational guide system of claim 1, further including a display device,"

217. As shown above, the combination of Poggi and SIMATIC discloses and renders obvious claim 1. [*See* my analysis above in Challenge 1A at [1.0] – [1.3].]

218. Both Poggi and Kaufman further teach claim element [9.0]. Poggi discloses a *display device*, namely graphic console 21 which is shown below in the annotated versions of Poggi Figures 1 and 2.

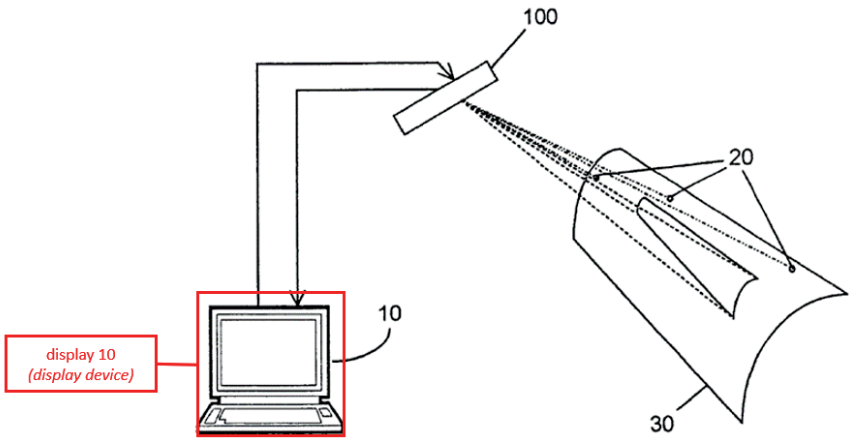


Poggi, Fig. 1 – Annotated.



Poggi, Fig. 2 – Annotated.

219. Similarly, Kaufman also teaches claim element [9.0] by disclosing a display 10[11], which is shown below in the annotated version of Kaufman Figure 1.



Kaufman, Fig. 1 – Annotated.

[9.1]: "and wherein said controller is programmable via at least one program screen displayable on said display device, said at least one program screen configured to include at least one input field for entering and/or selecting indicia regarding sequential actions;"

220. The combination of Poggi and Kaufman discloses this claim element.

221. This claim limitation refers to software that permits an operator to, for example, input or make changes to the manner in which sequential actions of

[11] Also referred to as "operator interface 10." [Kaufman 5:55-57.]

the guided operation are represented (i.e. *entering and/or selecting indicia*).[12] The '981 patent describes such functionality as follows:

> "The operational programming and use of an operational guide system will now be described with reference to FIGS. 3-5. FIG. 3 illustrates a ***program screen 100 that may be displayed*** or generated ***on a display device*** … Program screen 100 ***includes various fields*** 102,104,106, 108 for entering descriptive text regarding an operational step, for selecting a type of display graphic or visual display feature ("VDF") and characteristics for the VDF to be exhibited by an indicating light … and for programming the location at which an indicating light VDF will be directed via the control module.
>
> The VDF description field 102 ***enables the operational guide system to be sequentially programmed with progressive operational steps***, each of which may include certain selectively input descriptive text.
>
> …
>
> The VDF graphic selection field 104 ***enables various sub-steps or layers and graphics*** to be selected and

[12] *Indicia*, Merriam-Webster.com, https://www.merriam-webster.com/dictionary/indicia (defining indicia as "distinctive marks.")

programmed corresponding to a single operational step detailed in the VDF description field 102 noted above."

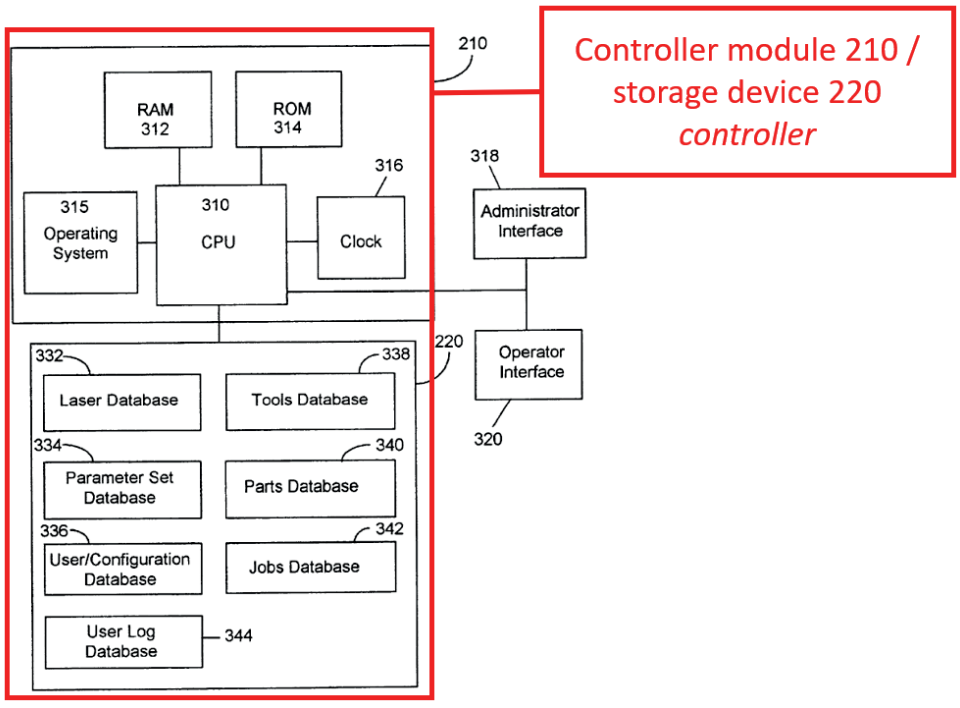
['981 patent at 13:22-13:50 (emphasis added); *see* also 13:47-14:52.]

222. In the above teachings, program screen 100 includes input fields 102 and 104 for entering *indicia* regarding *sequential actions*.

223. Both Poggi and Kaufman teach *said controller [being] programmable* through a similar software process. Poggi discloses "[t]he computer 20 was programmed to teach it the shape of each tooling 1 as well as the location and shape of the various layers that must be placed on this tooling 1." [Poggi, 3:27-30; *see also* Poggi, 4:13-15.] A POSITA would understand from this statement that a program screen exists somewhere in the Poggi system to implement this teaching functionality. However, Kaufman provides more detailed descriptions of two software programs—an operator program and an administrator program—both used to program the Kaufman controller. [*See* Kaufman at 8:28-32, 9:43-14:3, Figs. 10-17.]

224. As shown below in the annotated version of Kaufman Figure 7, the *controller* in Kaufman includes controller module 210 and its associated data storage device 220. The controller is further connected to an administrator interface 318 and an operator interface 320, which are on display screens associated with the administrator program and the operator

program, respectively. [*See, e.g.* Kaufman, 9:58-63, 12:28-33, 12:66-67.] A POSITA would also understand that both the administrator interface 318 and operator interface 320 can be configured to be displayable on display 10 (*display device*) in Kaufman. [*See* Kaufman, 5:54-57, 12:66-13:4 (using "operator interface 10" and "display 10" interchangeably to refer to personal computer illustrated as 10 in Figure 1); *see also* Kaufman, 9:50-56 (teaching both administrator and operator program may reside on "a personal computer.")]



Kaufman, Fig. 7 – Annotated.

225. Kaufman explains that its "controller module 210 is the brain of projector 100 [and] controls the operation of projector 100 in response to various

parameter inputs …" [Kaufman, 6:58-7:5.] Data storage device 220 is "coupled to controller module 210, may contain … various databases." As shown above in Figure 7, the controller module 210 is further "coupled" to a data storage device 220 including databases such as parts database 340. [*See* Kaufman, 6:58-7:5.]

226. The Kaufman controller is programmable via both the operator and administrator interfaces. [*See* Kaufman at 8:28-32, 9:43-14:3, Figs. 10-17.] Both programs further include *at least one program screen … configured to include at least one input field for entering and/or selecting indicia regarding sequential actions*. [*See* Kaufman, 9:43-14:3, Figs. 10-17.] As discussed in more detail below, the administrator program provides an administrator interface (*program screen*) displayable on display 10 (*display device*) that includes at least an *input field* used to "edit existing parts information" (*i.e.*, *indicia regarding sequential actions*) [Kaufman 11:52-53]. Similarly, the operator program provides an operator interface (*program screen*) displayable on Kaufman's display 10 (*display device*) that includes at least an *input field* to "select or deselect one or more of the parts" (*i.e.*, *indicia regarding sequential actions*) [Kaufman, 13:57-58].

227. Specifically, Kaufman discloses that the administrator can add, edit, or delete parts information, including the name of a part, via the Administrator

program. The text of Kaufman clarifies the capabilities of the administrator program by stating, "[p]arts database 340 contains each part name and the various layers that are incorporated into each part … ***Any of the information in parts database 340 may be changed at any time through the Administrator program***." [Kaufman at 8:17-30 (emphasis added); *see also* Kaufman, 11:43-63.]

228. To do so, after an administrator logs onto the system using administrator interface 318, "the administrator is ***presented*** with several options including … modifying parts information at step 600" for the administrator's selection. [Kaufman, 10:6-12 (emphasis added)]. When selected, "[t]he administrator is then given a choice of adding a new part[], editing existing parts information or deleting current parts information. If the administrator selects to add a new part at step 602, the administrator is then ***prompted to enter the new part's name and properties***." [Kaufman, 11:45-49 (emphasis added)]. Kaufman depicts the part-information-modification process via the administrator program, as shown in the lower portion of Kaufman Figure 12 reproduced below.

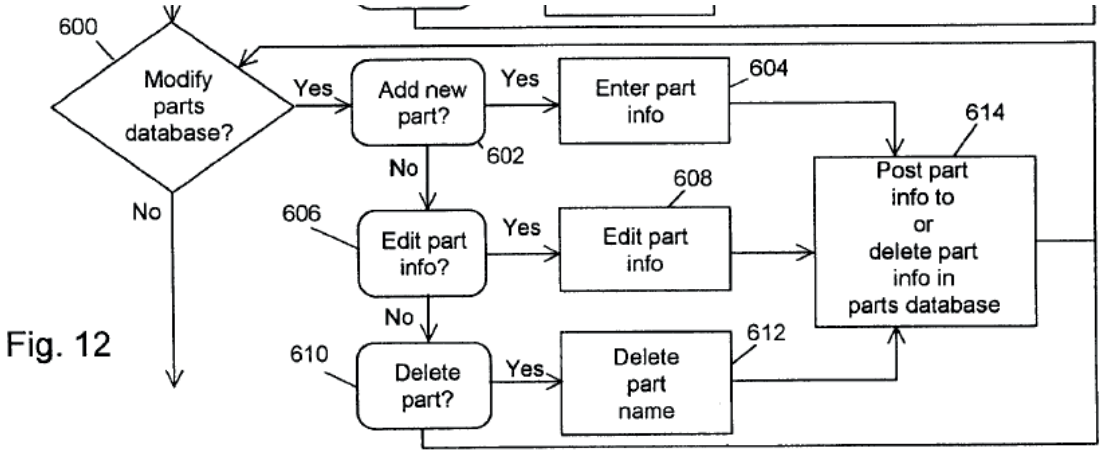


Fig. 12

Kaufman, Fig. 12 – Excerpted.

229. The parts as described above are *indicia regarding sequential actions*, because they represent "progressive operational steps, each of which may include certain selectively input descriptive text." ['981 patent, 13:35-37.] Specifically, each part in Kaufman represents a template for the hand lay-up operation and includes descriptive text in the form of a "part name." [Kaufman, 8:17-21.] In addition, each part in Kaufman also includes "various layers," each of which can function as a "sub-template" to the part's template. [Kaufman, 8:17-21.] In other words, the layers in the parts are also *indicia regarding sequential actions*. [*See* '981 patent, 13:47-59.]

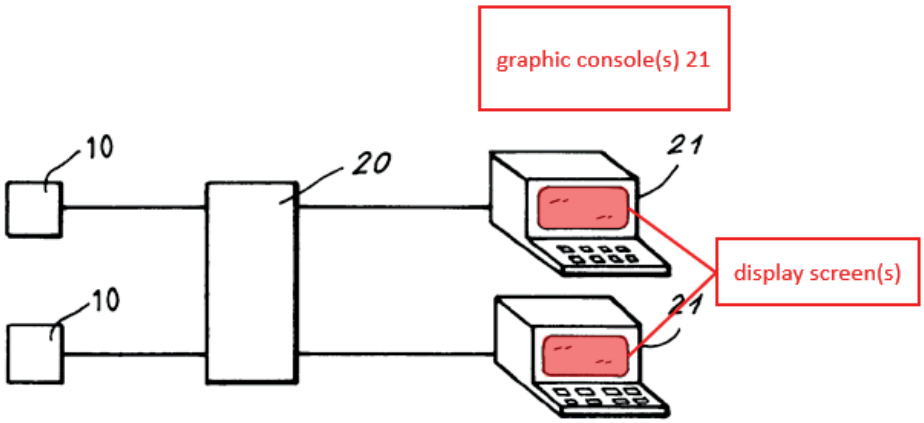
230. Accordingly, the administrator interface is a program screen configured to include input fields to enter and/or select indicia regarding sequential actions.

231. Thus, the combination of Poggi and Kaufman discloses claim element [9.1].

[9.2]: "said controller being further configured to display at least one display screen on said display device during operation of said operational guide system, said display screen being adapted to display indicia regarding sequential actions to be performed."

232. Both Poggi and Kaufman teach claim element [9.2].

233. As discussed above in Challenge 1A, [13.1], Poggi discloses a display device (graphic console 21). Said display device has at least a *display screen* as illustrated in the annotated version of Figure 2 below:



Poggi, Fig. 2 – Annotated.

234. Poggi discloses that this graphic console 21 displays *indicia regarding sequential actions to be performed* during a guided operation. For example, if a layer is incorrectly laid, "an error message is displayed on the graphic consoles 21 based on the results of the various comparisons." [Poggi, 4:9-11.] Poggi further discloses:

> "Other indications may also appear on the graphic consoles 21 if the programming of the computer 20

> allows it. In particular, it is possible to ***view the image on the screen of the tooling and the theoretical locations of the layers of the part***. The image collected by the cameras 11 of the lay-up actually carried out can also be viewed, superimposed on the previous one or on another screen. It is also possible to use video image reception stations directly connected to the cameras 11."

[Poggi, 4:13-21; *see also* 1:56-57.] The purpose of the schematic indications described above are "to facilitate [layer] placement by the operator." [Poggi, 1:56-57, 4:9-11.]

235. Kaufman also discloses to display at least one display screen on said display device during operation of said operational guide system, said display screen being adapted to display indicia regarding sequential actions to be performed. Kaufman's system includes "display 10." [Kaufman, 12:67; Fig. 1.] This display 10 can be used by an operator to display indicia regarding sequential actions to be performed:

> Turning now to FIG. 15, the operator may want to operate projector 100 to perform a particular job. At this point, the operator may choose a job at Step 824 or exit the program and system at step 825. If the operator wishes to perform a particular job, the operator selects the job at step 826. When the job is selected, all of the jobs data information is retrieved from jobs database 342

at step 828. **At step 830, the tool is displayed on display 10 of operator interface 320 and the system retrieves the user permissions profile and the job permissions at Step 832. A graphical user interface presents the operator with a variety of options that the operator may choose.** These options are to view job details at step 834, focus the laser at step 838, find the retro-reflective targets 20 at step 842, choose a particular part for the tool at step 844, change the selection of lasers for the job at step 846 in FIG. 16, change the selection of parts for the job at step 860, change the tool for the job at step 876 in FIG. 17, and exit the program at step 890.

[Kaufman, 12:60-13:10 (emphasis added).] Kaufman discloses other examples of using its display 10 to *display indicia regarding sequential actions to be performed*. [Kaufman at 13:16-18 (displaying job details); at 15:36-38 (operator marks actions as complete by "clicking on a particular layer.").] Each of these examples comprises display indicia regarding sequential actions to be performed that is displayed on said display device during operation of said operational guide system.

236. Accordingly, the combination of Poggi and Kaufman discloses claim element [9.3] and the combination of Poggi, SIMATIC, and Kaufman renders obvious claim 9.

3. Claim 10 Analysis

[10.0]: "The operational guide system of claim 9,"

237. As shown above, the combination of Poggi, SIMATIC, and Kaufman renders obvious claim 9. [*See* analysis above in [9.0] – [9.3].]

[10.1]: "wherein said at least one input field comprises at least one selected from the group consisting of a description field, a graphic field, and a location field,"

238. Kaufman discloses claim element [10.1].

239. As discussed above in [9.2], Kaufman discloses *input field[s] for entering and/or selecting indicia regarding sequential actions*, including at least those for (1) selecting/deselecting parts in the operator interface, and (2) entering, editing, and/or deleting part information (and/or part names) in the administrator interface.

240. The *input fields* in Kaufman include at least *description field[s]*. To clarify, the '981 patent describes a *description field* "is configured to enable programming of descriptive text associated with sequential actions," ['981 patent, 19:42-44 (claim 10)], such as "enter[ing] or typ[ing] in VDF description sub-field 112." ['981 patent, 13:40-41.]

241. For example, Kaufman's input fields for entering and/or editing part information (including part names) in the administrator interface are *description field[s]*. [*See, e.g.*, Kaufman at 11:47-55 ("If the administrator selects to add a new part at step 602, the administrator is then prompted to enter the new part's name and properties at step 604. … If the administrator selects to edit existing parts information at step 606, the administrator then selects the part name to edit and is allowed to edit the part properties at step 608"); *see also* Kaufman, 11:64-12:18, Fig. 13.]

242. Thus, the combination of Poggi, SIMATIC, and Kaufman renders obvious claim element [10.1].

[10.2]: "and wherein said description field is configured to enable programming of descriptive text associated with sequential actions, said graphic selection field is configured to enable programming of an image formed by said at least one indicating light, and said location field is configured to enable programming of the location at which said at least one directional light device projects said at least one indicating light."

243. The combination of Poggi and Kaufman discloses claim element [10.2].

244. As discussed above in [10.1], Kaufman's input fields for entering and/or editing part information (including part names) are *description field[s] [] configured to enable programming of descriptive text* because they allow the entering and/or editing of texts (*i.e.*, part name). The part name is further *associated with sequential actions* because it describes the set of layers that

make up a part. As discussed above in [9.1], each of the layers is *associated with sequential actions*.

245. Accordingly, Kaufman discloses claim element [10.2] and the combination of Poggi, SIMATIC, and Kaufman renders obvious claim 10.

4. Claim 18 Analysis

[18.0]: "The method of claim 14,"

246. As shown above, the combination of Poggi and SIMATIC renders obvious claim 14. [*See* analysis above Challenge 1A at [14.0] – [14.5].]

[18.1]: "wherein projecting at least one indicating light comprises projecting at least one indicating light in a selectively configurable pattern."

247. The combination of Poggi and Kaufman discloses [18.1].

248. As discussed above in Challenge 1A at [1.3] and [14.4], Poggi discloses *projecting at last one indicating light* by projecting images to locations where the next layer should be placed. This process further *comprises projecting at least one indicating light in a selectively configurable pattern*, because Poggi's computer 20 "was programmed to teach it the … shape of the various layers that must be placed." [Poggi, 3:27-30].

249. Kaufman expands on this programming step. Specifically, a user in Kaufman can *selectively configure* images to be projected (*i.e.*, *pattern[s]* for *projecting at least one indicating light*), including the "series of points"

defining layers in a part, through the administrator interface 318 and/or operator interface 320. [Kaufman, 8:17-31, 11:43-57; *see* analysis above in Challenge 1B at [9.2], [10.1].] Kaufman also discloses "project[ing] the layer or layers with projector 100 onto object 30." [Kaufman, 15:10-21]. Accordingly, the combination of Poggi and Kaufman discloses *wherein projecting at least one indicating light comprises projecting at least one indicating light in a selectively configurable pattern.*

250. Therefore, the combination of Poggi, SIMATIC, and Kaufman renders obvious claim 18.

5. Claim 22 Analysis

[22.0]: "The method of claim 14, including: programming the controller via at least one program screen displayable on the display device, the at least one program screen configured to include at least one input field for entering and/or selecting indicia regarding sequential actions; and"

251. As shown above, the combination of Poggi and SIMATIC renders obvious claim 14. [*See* analysis above in Challenge 1A at [14.0] – [14.5].]

252. Poggi and Kaufman disclose the remainder of this claim element. [*See* analysis above in Challenge 1B at [9.1].]

[22.1]: "displaying indicia regarding sequential actions to be performed on at least one display screen displayable on the display device."

253. Poggi and Kaufman disclose this claim element. [*See* analysis above in Challenge 1B at [9.2].]

254. Accordingly, the combination of Poggi, SIMATIC, and Kaufman renders obvious claim 22.

6. Claim 24 Analysis

[24.0]: "The operational guide system of claim 2, further including a display device, and wherein said controller is programmable via at least one program screen displayable on said display device, said at least one program screen configured to include at least one input field for entering and/or selecting indicia regarding sequential actions;"

255. As shown above, the combination of Poggi and SIMATIC renders obvious claim 2. [*See* analysis above in Challenge 1A at [2.0] – [2.1].]

256. Poggi and Kaufman disclose the remainder of this claim element. [*See* analysis above in Challenge 1B at [9.0] – [9.1].]

[24.1]: "said controller being further configured to display at least one display screen on said display device during operation of said operational guide system, said display screen being adapted to display indicia regarding sequential actions to be performed."

257. Poggi and Kaufman disclose this claim element. [*See* analysis above in Challenge 1B at [9.2].]

258. Accordingly, the combination of Poggi, SIMATIC, and Kaufman renders obvious claim 24.

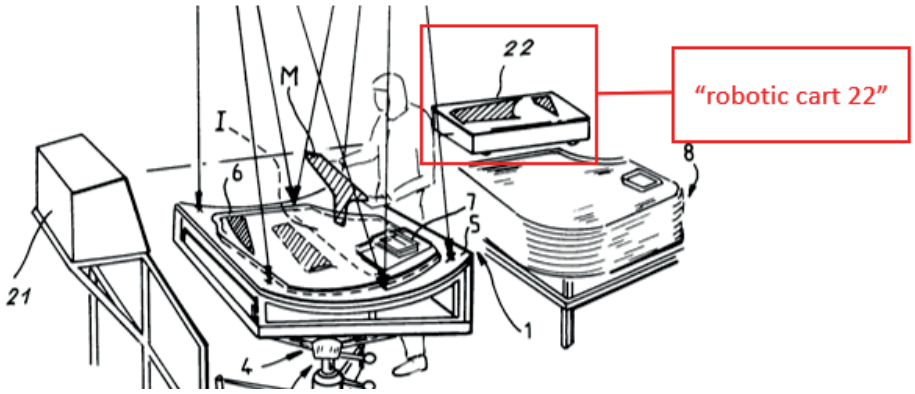
C. CHALLENGE 1C: Claims 3 and 8 Are Obvious over Poggi-SIMATIC in view of Pinhanez

1. Rationale for combining Poggi-SIMATIC and Pinhanez

259. As discussed above in Section XI.A, the combined system of Poggi-SIMATIC uses the assembly support system in Poggi and substitutes in the smart cameras from SIMATIC. Both Poggi-SIMATIC and Pinhanez are analogous systems to the '981 patent, because both are directed to the field of interactive computer applications—particularly those that project instructions to operators to aid them in completing a task. [Poggi, Abstract, 1:50-57; Pinhanez, 2-3.] Both systems are further reasonably pertinent to the same problem as the '981 patent, namely, how to guide human operators in assembly tasks, including by projected light. [*See, e.g.*, '981 patent at 1:16-19 ("system for guiding an individual in the performance of operational steps, and … provid[ing] visual indicators to the individual.")]

260. A POSITA would have been motivated to combine Poggi-SIMATIC and Pinhanez for the reasons discussed below. The same reasons further go to show that a POSITA would have had a reasonable expectation of success combining them.

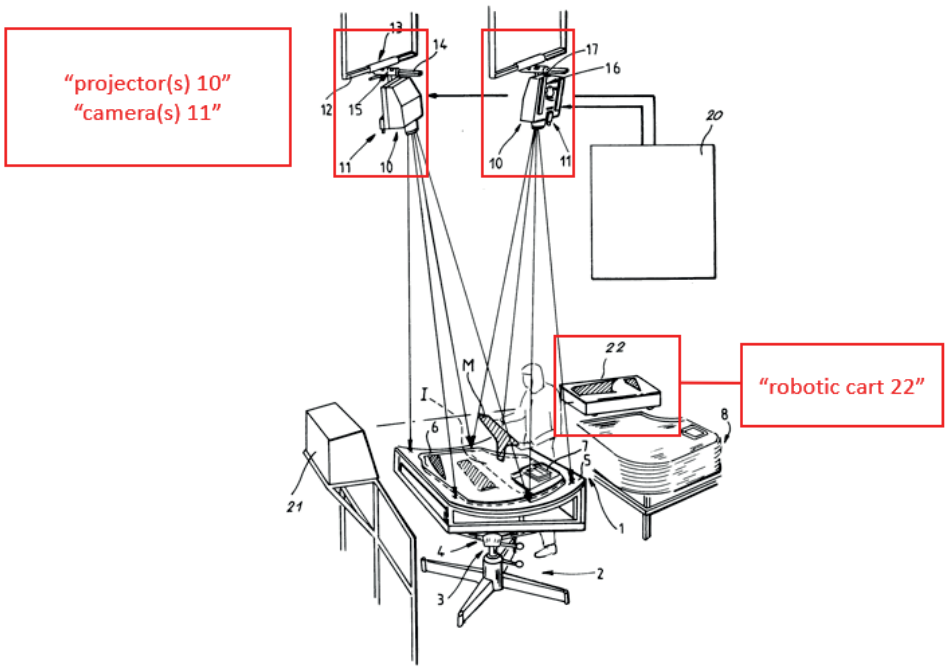
261. First, Poggi discloses storing components required for the assemblies on a cart. [*See* Poggi at 4:22-24 ("robotic cart 22 that provides the operator with all the pieces necessary to lay up the part"); *see also* Poggi at Fig. 1.] This arrangement is illustrated below in an annotated version of Poggi Figure 1.



Poggi, Fig. 1 – Annotated.

The overall work area, as well as the surface of the robotic cart and the area where the layers are assembled, make up a *work station*.

262. While Poggi does not explicitly teach the use of its projector to indicate exactly where a particular component is located on the cart, Poggi's image projection system has the capability to project indicating light at the cart. "The ball joint 17 allows the projector 10 and the camera 11 to turn in all directions," and the connection between projector 10 and fork 16 makes it "possible to adjust the position of the projector 10 and the camera 11 in all directions." [Poggi, 3:11-16, Fig. 1.] It is thus possible to aim Poggi's projector light at the cart. The large possible projection area, as well as the proximity of the storage cart is illustrated in annotated Fig. 1 below.



Poggi, Fig. 1 – Annotated.

263. On the other hand, Pinhanez specifically discloses using a steerable projector-camera system to indicate stored component locations as part of an assembly operation (i.e. projecting light on a storage bucket containing M&M's used to assemble a pixelated artwork). It would have been obvious to use Pinhanez's technique for highlighting the locations of stored components with Poggi's component storage cart. Like Pinhanez, the assembly operation in Poggi requires the assembly of different components (layers of different shapes), to an underlying work piece. It would have been obvious and helpful to store those different components in pre-set locations on the component cart, as disclosed in Pinhanez, to keep the components organized. It would further have been obvious and helpful to use one of the

projectors already used by the Poggi-SIMATIC system to point out the locations where the required components are stored. This would assist the operator in finding such components more quickly and with great reliability. Thus, implementing Poggi-SIMATIC with the storage-bucket-highlighting feature in Pinhanez would have been obvious because Pinhanez and Poggi-SIMATIC are similar devices that would be improved in the same way from such an implementation.

264. The fact that in this combination Poggi uses the SIMATIC cameras does not make a difference because Poggi and Pinhanez alone supply the additional requirements of claims 3 and 8, as explained more fully below. Additionally, those claims do not contain any additional requirements relative to the *sensor apparatus* and do not implicate any SIMATIC functionality identified relative to the independent claims.

265. Second, the combination of Poggi-SIMATIC and Pinhanez is the use of a known technique (Pinhanez's storage indicator) to a known device (Poggi-SIMATIC) ready for improvement to yield the predictable results of decreased assembly time and increased reliability. Notably, both Poggi-SIMATIC and Pinhanez disclose similar systems to that of the '981 patent in "human performance of particular tasks that are desired to be performed without omitting any steps" such as "multi-person choreographed physical

activities" (*e.g.*, assembling a picture made of M&M's by multiple users). ['981 patent at 1:55-63; Poggi, 1:16-18; Pinhanez, 3.]

266. Third, market forces—including the need to shorten assembly cycle time and reduce human error in identifying components—would have led a POSITA to implement Poggi-SIMATIC with the teachings of highlighting stored component locations in Pinhanez. This is especially so because Poggi-SIMATIC and Pinhanez are both directed to the same specific application: projecting instructions to operators in order to aid them in completing a task.

2. Claim 3 Analysis

[3.0] "The operational guide system of claim 2,"

267. As shown above, the combination of Poggi and SIMATIC renders obvious claim 2. [*See* analysis above in Challenge 1A at [2.0] – [2.1].]

[3.1]: "wherein said at least one indicating light is projected at a component location, said component location retaining a part required for assembly at said work station."

268. Pinhanez discloses [3.1].

269. Pinhanez discloses using projected light to highlight a storage bucket containing parts used in an assembly, as shown in the annotated version of Pinhanez Figure 2 provided below.

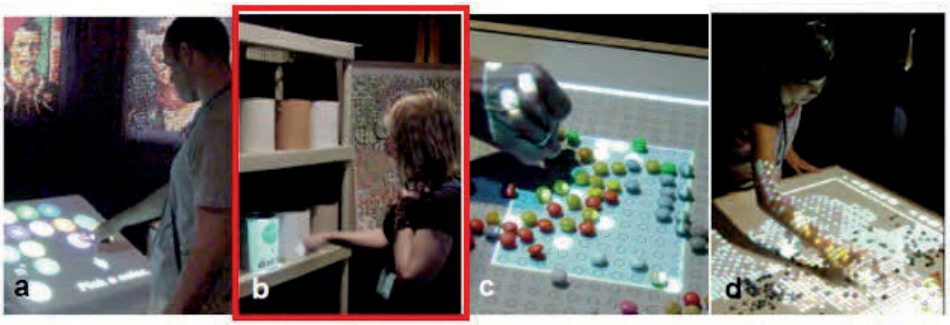


Figure 2. The M&M picture assembly task: a) choosing a color; b) "clicking" a bucket after getting the M&Ms; c) placing the M&Ms on the highlighted areas; and d) "finger painting" to reveal the complete picture.

Pinhanez, Fig. 2 – Annotated.

270. In this example, Pinhanez discloses a directional light device (ED-projector) projecting *at least one indicating light at a component location.* Specifically, Pinhanez discloses using projected light to highlight a storage bucket containing a *part required for assembly*. (M&M's of a specific color). Pinhanez's *work station* is shown above in Figures 2c and 2d. Pinhanez describes this system as follows:

> "Interaction: as the user enters the environment, she is asked to touch a picture projected on a board to activate the system. The system responds by projecting an instruction asking the user to go to the selection area. The interface is then steered towards a table. Figure 2.a shows this table as it is transformed into an interactive menu for color selection. The user simply touches the color of his choice to select it. Then the user receives a projected instruction prompting him to look for a highlighted bucket. In Figure 2.b, **the system highlights the bucket that contains the M&M's of the selected color** and

provides additional information on how many M&M's to extract from the bucket."

[Pinhanez at 3 (pdf pagination) (emphasis added).]

271. Thus, Pinhanez discloses projecting an *indicating light* at a *component location retaining a part required for assembly at said work station* by disclosing highlighting the bucket where M&M's are stored, so that such M&M's can be used to assemble a picture composed of M&M's on a flat table (the *work station*).

272. Accordingly, Pinhanez discloses claim element [3.1] and the combination of Poggi, SIMATIC, and Pinhanez renders obvious claim 3.

3. Claim 8 Analysis

[8.0] "The operational guide system of claim 1,"

273. As shown above, the combination of Poggi and SIMATIC renders obvious claim 1. [*See* analysis above in Challenge 1A at [1.0] – [1.3].]

[8.1]: "wherein said at least one indicating light is produced by at least one high intensity light emitting device selected from the group consisting of a laser projector, a digital light projector, and a liquid-crystal display."

274. Poggi discloses using "a projector 10 of video images." [Poggi, 3:4.] However, Poggi does not specifically mention using any of the enumerated projector types as part of its system (and in fact seeks to be an improvement over laser-based systems). [Poggi, 3:4; 1:25-48.]

275. To the extent the phrase *liquid crystal display* covers an LCD projector, Pinhanez discloses the claimed *produc[ing] [an] indicating light with a high intensity light emitting device*.

> "The applications described in this paper use a device to create steerable interfaces called the *Everywhere Displays projector (ED-projector)* [2]. Figure 1 shows a prototype of this device, made of off-the-shelf components: **a LCD projector**, a pan/tilt mirror used in theatrical lighting, and a videoconference pant/tilt/zoom camera."

276. [Pinhanez at 2 (pdf pagination) (emphasis added); *see also* Pinhanez at 1 (pdf pagination).] It would have been obvious to a POSITA that an LCD projector is one way to implement Poggi's "projector 10 of video images," because Pinahez's projector is simply an "off-the-shelf" component and Poggi does not place any special functional requirements on its projector.

277. Accordingly, Pinhanez discloses claim element [8.1] and the combination of Poggi, SIMATIC, and Pinhanez renders obvious claim 8.

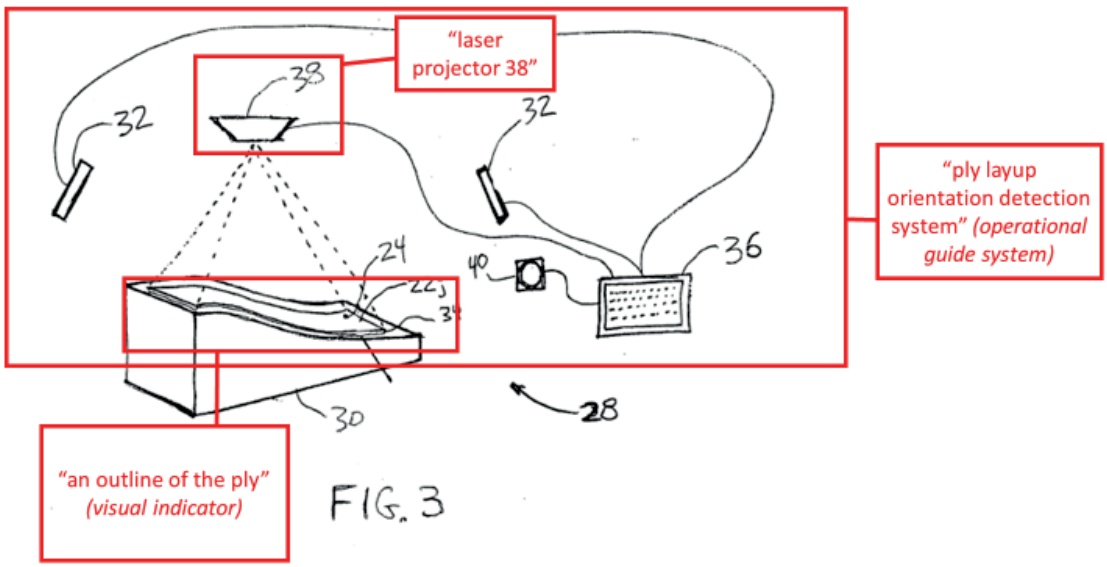
D. Challenge 2A: Claims 1-2, 4-6, 8, and 11-12 are anticipated by Green

1. Claim 1 Analysis

[1.0] An operational guide system adapted to provide visual indicators to an individual to guide sequential actions, said operational guide system comprising:

278. To the extent the preamble is limiting, Green discloses *an operational guide system adapted to provide visual indicators to an individual to guide*

sequential actions. Specifically, Green discloses a "ply layup orientation detection system" for "identifying composite plies and [e]nsuring a correct layup sequence, as well as a correct location and orientation are used during panel fabrication." [Green ¶¶ [0018], [0021]-[0022].] As shown in annotated Figure 3 below, Green's system includes "a laser projector 38" that "project[s] an outline of the ply" to "display a proper orientation for the ply" to the system's operator. [Green ¶¶ [0020], [0023].] These "project[ions] [of] an outline of the ply" are *visual indicators*.



Green, FIG. 3 – Annotated.

Green's "ply layup orientation detection system" provides visual indicators on where an individual should place objects and is, therefore, *an operational guide system*. [Green ¶¶ [0021]-[0022].] Moreover, each ply used in

Green's composite panel assembly process is one of a "sequence" of plies added during a series of sequential actions. [Green ¶¶ [0020], [0023].] Therefore, Green's system is *adapted to provide visual indicators to an individual to guide sequential actions.*

279. Thus, Green discloses [1.0].

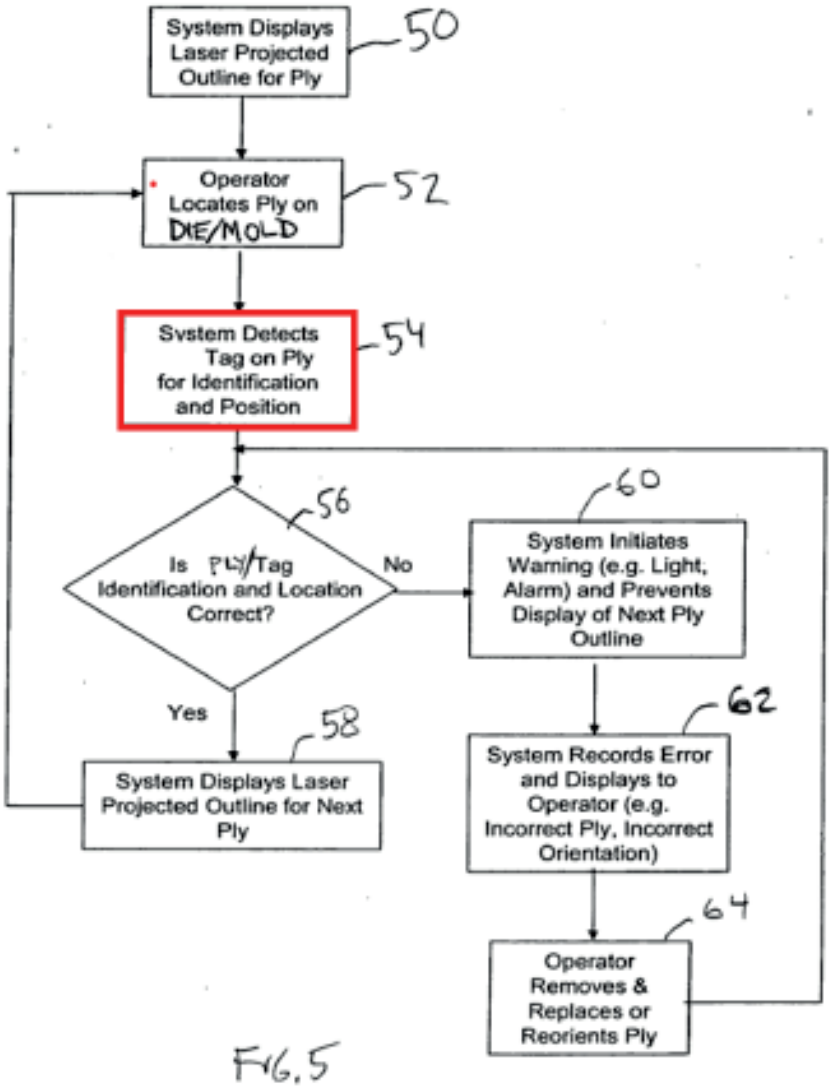
[1.1] at least one sensor apparatus, said at least one sensor apparatus operable to detect operation information and generate an output indicative of said operation information;

280. Green discloses at least one sensor apparatus, said at least one sensor apparatus operable to detect operation information and generate an output indicative of said operation information. Green discloses "tag sensors 32," which include at least one sensor apparatus. [Green ¶ [0023], [0025].] Each tag sensor 32 "may scan/read" "electronically identifiable tag 24" attached to "each ply." [Green ¶ [0023].] Green discloses that its "electronically identifiable tags 24" may be any suitable tag, including a tag having "marks or dots painted or affixed on one or more of the plies 22a-22e, that may be detected by a vision system/optical sensor; a radio frequency identification (RFID) tag; another passive electronic tag device; and/or an active electronic tag device." [Green ¶ [0019]].

281. Green discloses that as each ply is laid up in a sequence of actions to create the composite panel, computer system 36 "associate[s] each electronically

identifiable tag 24 with a part number and a ply number." [Green ¶ [0024].] When tag sensor 32 reads the electronically identifiable tag attached to a ply, it *detect[s] operation information* about that ply. The '981 patent explicitly states that *operation information* includes information about "the presence and/or type of work piece 14 located at the work station 16." [*See* '981 patent at 5:35-38.] Therefore, when Green's tag sensor 32 "scan[s]/read[s] each electronically identifiable tag 24 in … each ply," [Green ¶ [0023]], and detects information regarding the presence of the ply at a work station and identification information associated with the ply, tag sensor 32 *detect[s] operation information*. Notably, the '981 patent describes using a tag identification sensor as one example of *detecting operation information*. ['981 patent, 5:35-53.]

282. After reading an electronically identifiable tag, Green's tag sensor 32 "transmit[s] appropriate data to the computer system 36 to confirm that each ply is being placed in a proper layup sequence and orientation." [Green ¶ [0023].] As shown in annotated Figure 5 below, once computer system 36 receives data from tag sensor 32, "computer system 36 and the tag sensors 32 may be used to detect the identification and position of the ply … ." [Green ¶ [0025].]



Green, FIG. 5 – Annotated.

283. A POSITA would understand from this figure and the related text that Green teaches that based on the information from tag 24 that is sent to the computer system 36, the computer system 36 can determine the identification and position of the ply. [Green ¶ [0025], FIG. 5.] Thus, the tag sensor *generate[s]* and sends to the computer system *an output*

indicative of the *operation information* that the tag sensor detected from the electronically identifiable tag (i.e. presence of a ply and its identification information).

284. Thus, Green discloses [1.1].

[1.2] a controller, said controller receiving at least a first input signal indicative of said operation information and selectively providing at least one command signal in response to said first input signal; and

285. Green discloses a controller, said controller receiving at least a first input signal indicative of said operation information and selectively providing at least one command signal in response to said first input signal. As explained above with regard to [1.1], Green teaches that its "computer system 36" receives "appropriate data" from "tag sensor 32" regarding electronically identifiable tags that is indicative of operation information. [Green ¶ [0023].] Green's "computer system 36" is "operatively connected to a laser projector 38" to control its "display [of] a laser projected outline," and thus is a controller. [Green ¶ [0023], [0025].] The "appropriate data" controller 36 receives from "tag sensor 32" is a first input signal. Annotated Figure 3 below shows the connection by which computer 36 (a controller) receiv[es] a first input signal indicative of said operation information from tag sensor 32:

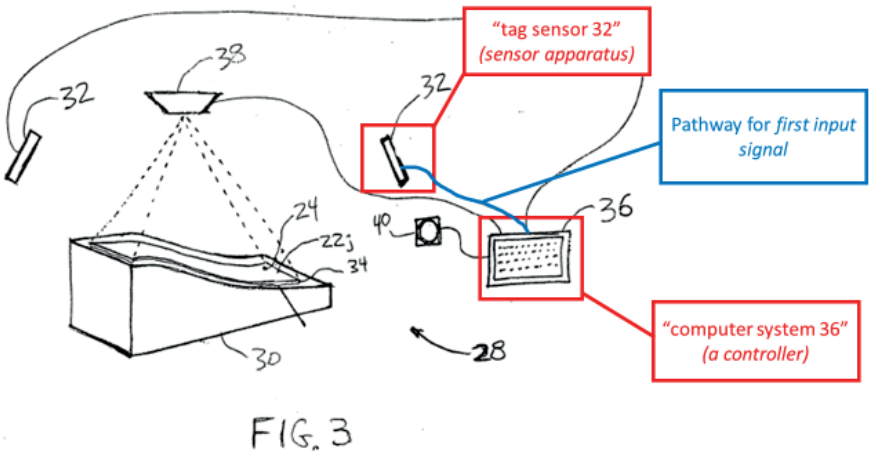
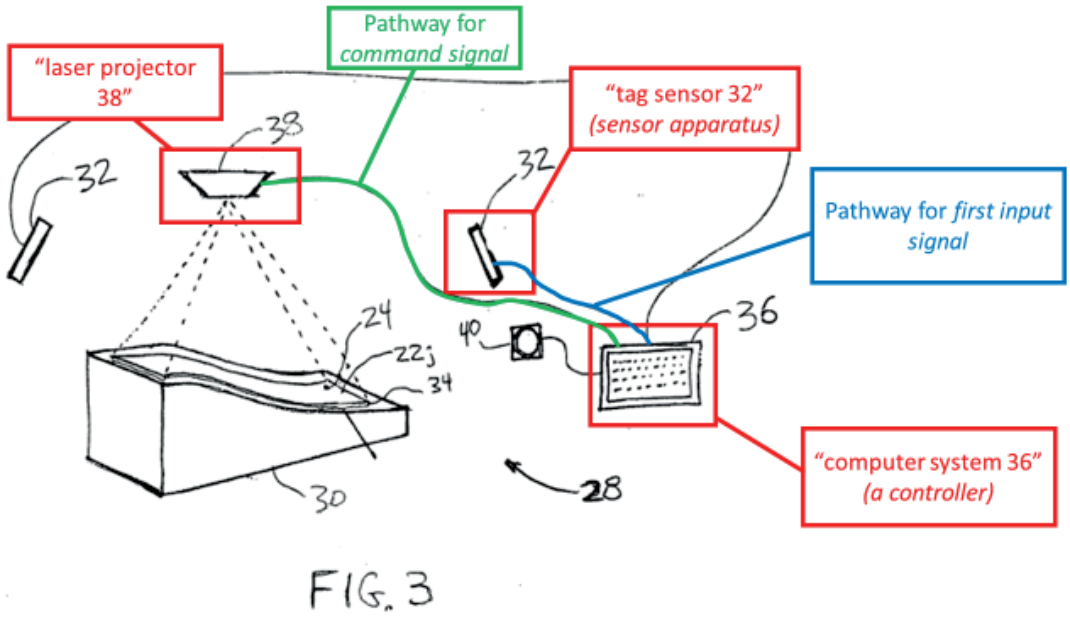


FIG. 3

Green, FIG. 3 – Annotated.

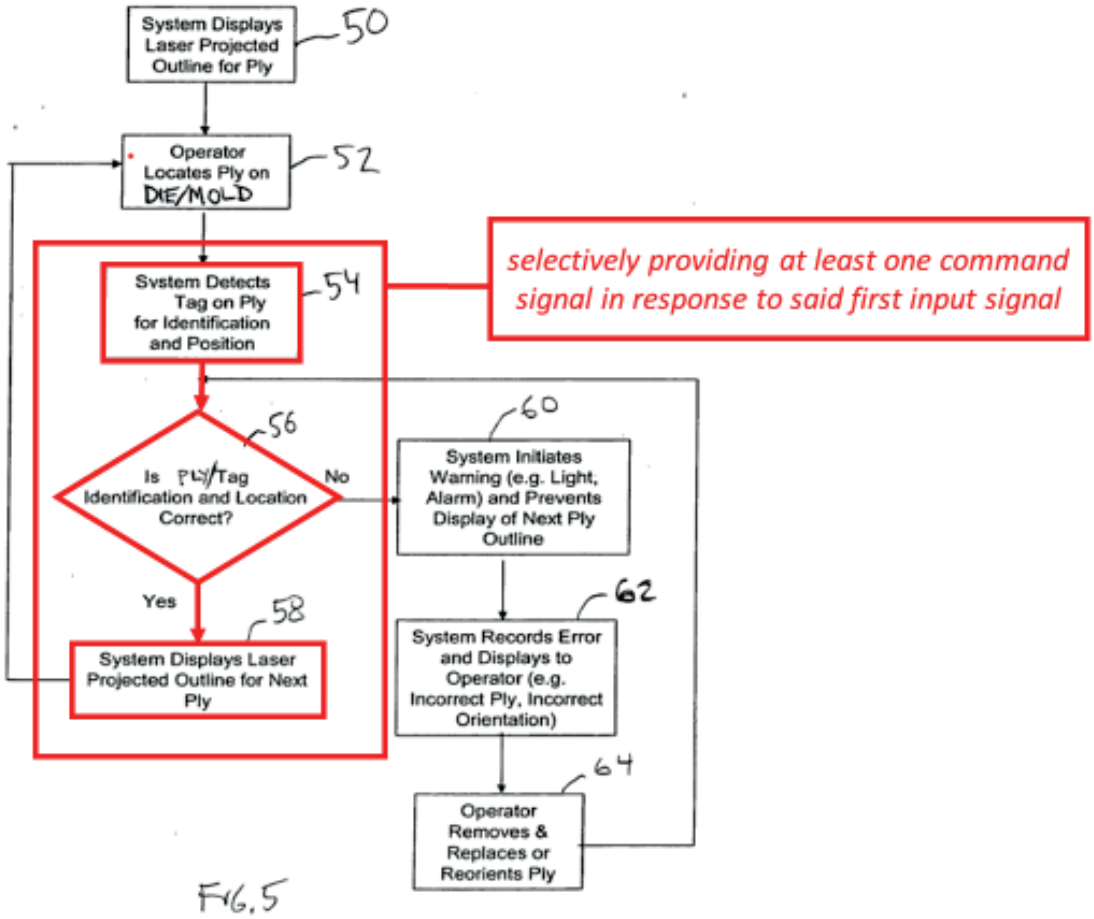
286. As explained above for [1.1], based on the *first input signal* from tag sensor 32, computer system 36 determines the identification and position of the ply most recently placed on the layup table. [Green ¶ [0025], Fig. 5.] "If the identification and location of the ply detected … is correct, the computer system 36 and laser projector 38 display a laser projected outline for the next ply." [Green ¶ [0025].] By causing laser projector 38 to display a laser projected outline for the next ply, Green's computer system 36 *selectively provid[es] at least one command signal* to laser projector 38. The *command signal* is computer system 36's instruction to display an outline. Computer system 36 sends this *command signal in response to said first input signal* because it depends on whether the "identification and location of the ply detected … is correct." [Green ¶ [0025].] Annotated Green Figure 3 below

shows an example of the connections between tag sensor 32, computer system 36, and laser projector 38, and the pathways for the *first input signal* and *command signal* transmitted between them.



Green, FIG. 3 – Annotated.

287. Green's annotated Figure 5 below further shows a flow chart of the process by which computer system 36 *selectively provid[es] at least one command signal in response to said first input signal*:



Green, FIG. 5 – Annotated.

288. Thus, Green discloses [1.2].

[1.3] at least one directional light device, said at least one directional light device selectively operable to project and target at least one indicating light in response to said at least one command signal from said controller.

289. Green discloses at least one directional light device, said at least one directional light device selectively operable to project and target at least one indicating light in response to said at least one command signal from said

controller. As discussed above with regard to [1.2] and shown in annotated Figure 3 below, Green discloses "laser projector 38," which is *at least one directional light device*.)

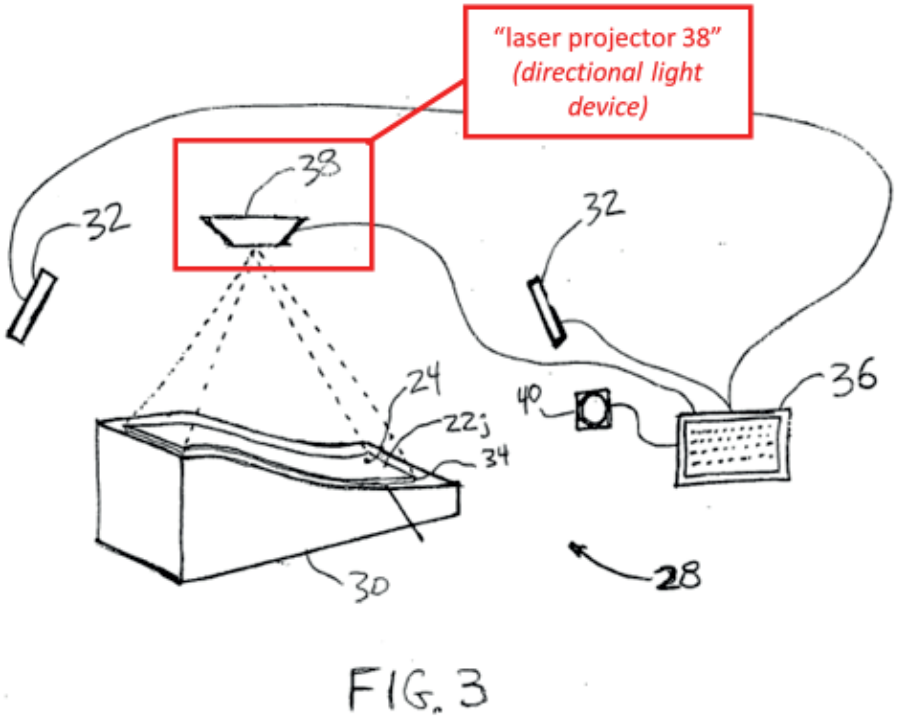
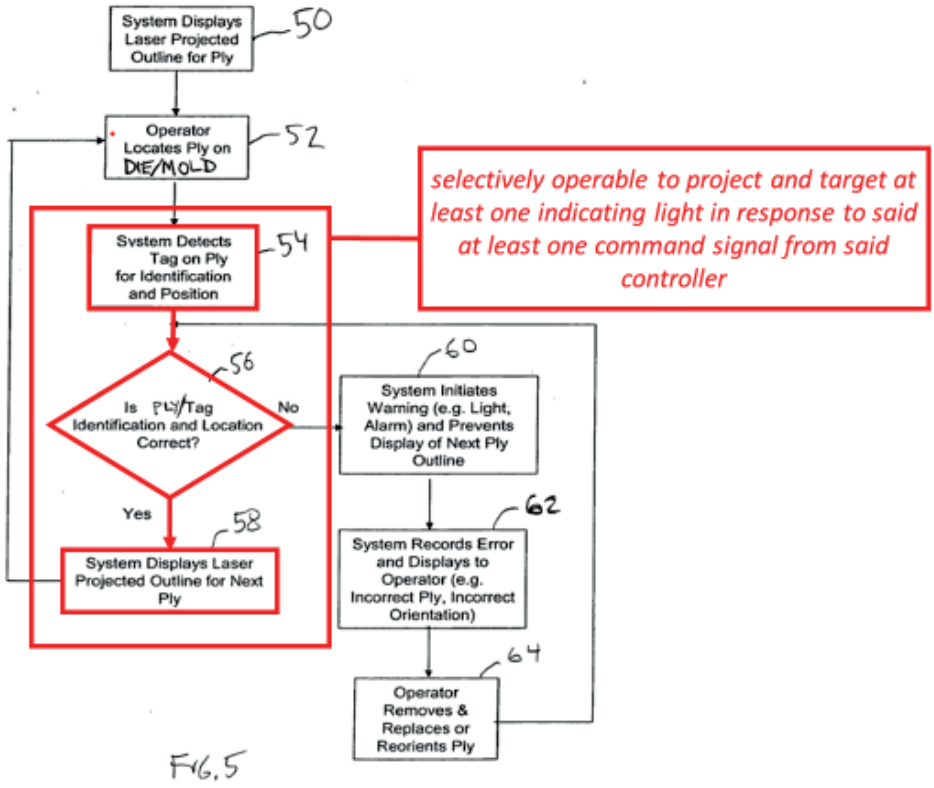


FIG. 3

Green, FIG. 3 – Annotated.

290. As explained above with regard to [1.2], "[i]f the identification and location of the ply detected … is correct, the computer system 36 and laser projector 38 display a laser projected outline for the next ply." [Green ¶ [0025].] Thus, Green's laser projector 38, the *directional light device*, is *selectively operable to project and target at least one indicating light in response to said at least one command signal from* computer system 36, the *controller* in

Green. Laser projector 38 *target*[s] its indicating light because it must aim its light at the specific location where the next ply needs to be placed. The process by which laser project 38 *selectively project[s] and target[s] at least one indicating light in response to said at least one command signal from said controller* is illustrated in annotated Green Figure 5 below:



Green, FIG. 5 – Annotated.

291. Thus, Green discloses [1.3]. Because Green discloses all limitations of claim 1, Green anticipates claim 1.

2. Claim 2 Analysis

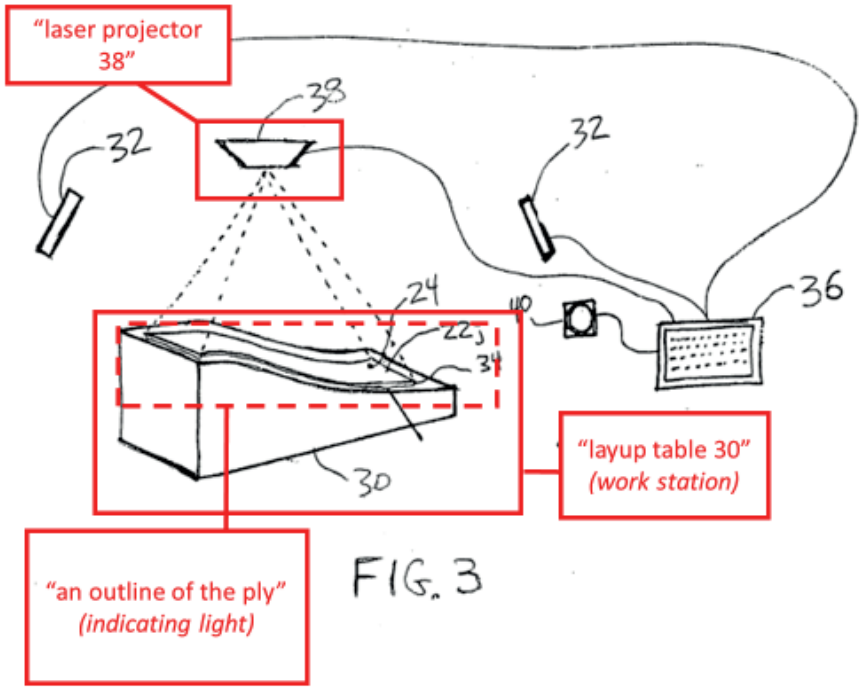
[2.0] The operational guide system of claim 1,

292. As explained above, Green anticipates the operational guide system of claim 1.

[2.1] wherein said at least one indicating light is provided to an operator performing an assembly action at a work station.

293. Green discloses wherein said at least one indicating light is provided to an operator performing an assembly action at a work station.

294. Green discloses that "laser projector 38 may be used to project an outline showing the proper positioning of a ply," which is an *at least one indicating light*. [Green ¶ [0025].] Laser projector 38 projects the outline "on the layup table 30." [Green ¶ [0023].] By projecting the outline "on layup table 30," laser projector 38 projects its *indicating light at a workstation*. The *operator* of the ply layup process then places "the ply on the layup table 30 in accordance with the projected outline" and repeats these steps with multiple layers of ply to form a "composite panel." [Green ¶¶ [0025], [0008], [0010], Fig. 5.] Placing layers for "manufacturing composite structures" is performing an *assembly action*. [Green ¶ [0002].] Thus, as shown in annotated Figure 3 below, Green's *indicating light* is *provided to an operator performing an assembly action at a work station*:



Green, FIG. 3 – Annotated.

295. Thus, Green anticipates claim 2.

3. Claim 4 Analysis

[4.0] The operational guide system of claim 2,

296. As explained above, Green anticipates *the operational guide system of claim 2*.

[4.1] wherein said operation information comprises identification of a presence of a work piece at said work station.

297. Green discloses operation information [that] comprises identification of a presence of a work piece at said work station.

298. Green discloses that, at each step in its assembly process, the operator places plies onto the layup table 30 (*work station*). [Green ¶ [0023].] As explained above for [1.1], Green's tag sensor 32 detects *operation information* by detecting the presence of electronically identifiable tags located on the plies, which the system associates with part numbers. [Green ¶¶ [0020], [0023-0025].] Because Green's *operation information* conveys the presence of plies in the set of already-placed plies (the *work piece*), Green's *operation information comprises identification of a presence of a workpiece at said work station*.

299. Thus, Green anticipates claim 4.

4. Claim 5 Analysis

[5.0] The operational guide system of claim 4,

300. As explained above, Green anticipates *the operational guide system of claim 4*.

[5.1] wherein said operation information comprises identification of a type of the work piece at said work station, and wherein said at least one command signal is selectively provided depending on the type of the work piece identified.

301. Green discloses operation information [that] comprises identification of a type of the work piece at said work station, and wherein said at least one command signal is selectively provided depending on the type of the work piece identified.

302. As explained above for [1.1] and [4.1], Green's tag sensor 32 detects *operation information* by detecting which electronically identifiable tags are present at the *work station*. [Green ¶ [0024].] Each of Green's electronically identifiable tags is associated with a part number. [Green ¶ [0024] ("Next, at 48 the computer system 36 may associate each electronically identifiable tag 24 with a part number and a ply number.")] Thus, because each of Green's tags is assigned to a specific part number, reading those tags allows Green's computer to identify the *type of the workpiece* present. [Green ¶ [0025] ("Next, the computer system 36 and the tag sensors 32 may be used to detect the identification and position of the ply, as indicated at 54.")] Thus, Green's *operation information comprises identification of a type of a workpiece at said work station*.

303. Green teaches "computer system 36 may further be operatively connected to a laser projector 38" to provide a signal (*command signal*) to "display a laser projected outline for the next ply" if, based on the information from tag sensor 32, "the identification and location of the ply detected … is correct." [Green ¶¶ [0023], [0025], Fig. 5 (56-58).] Computer system 36 does not provide the signal to laser projector 38 if the current ply is not in the proper "sequence" and "orientation." [Green ¶¶ [0023], [0025], Fig. 5 (56-64).] Thus, *depending on the type* (identification) of the *work piece* (ply),

computer system 36 *selectively provide[s]* a *command signal* to laser projector 38.

304. Thus, Green anticipates claim 5.

5. Claim 6 Analysis

[6.0] The operational guide system of claim 2,

305. As explained above, Green anticipates *the operational guide system of claim 2*.

[6.1] wherein said at least one indicating light is projected at a work piece to indicate an operation step location.

306. Green discloses at least one indicating light [that] is projected at a work piece to indicate an operation step location.

307. Green discloses that its "laser projector 38 may be used to project an outline showing the proper positioning of a ply on the layup table 30," such as overlapping with a plurality of other plies in the layup. [Green ¶ [0025], Fig. 2.] "If the identification and location of the ply detected at 54 is correct, the computer system 36 and laser projector 38 display a laser projected outline for the next ply." [Green ¶ [0025].] Thus, Green discloses *at least one indicating light* (laser outline) that *is projected at a workpiece* (the set of already-placed plies) *to indicate an operation step location* ("proper positioning of a ply"). [Green ¶ [0025].]

308. Thus, Green anticipates claim 6.

6. Claim 8 Analysis

[8.0] The operational guide system of claim 1,

309. As explained above, Green anticipates *the operational guide system of claim 1*.

[8.1] wherein said at least one indicating light is produced by at least one high intensity light emitting device selected from the group consisting of a laser projector, a digital light projector, and a liquid-crystal display.

310. Green discloses at least one indicating light [that] is produced by at least one high intensity light emitting device selected from the group consisting of a laser projector, a digital light projector, and a liquid-crystal display.

311. Green discloses that its "laser projector 38," which is a *high intensity light emitting device* that is *a laser projector*, "display[s] a laser projected outline for the next ply," which is an *indicating light*. [Green ¶ [0025].]

312. Thus, Green anticipates claim 8.

7. Claim 11 Analysis

[11.0] The operational guide system of claim 1,

313. As explained above, Green anticipates *the operational guide system of claim 1*.

[11.1] wherein said controller is configured to monitor operational information associated with sequential actions.

314. Green discloses a controller [that] is configured to monitor operational information associated with sequential actions.

315. The term "operational information" is not used in the specification, and I understand that Amazon has taken the position in related district court litigation that the term is indefinite. Nevertheless, claim 12 of the '981 patent demonstrates that "operational information" includes at least "an incorrectly performed action." ['981 patent, claim 12.] Consistent with claim 12 of the '981 patent, Green discloses *wherein said controller is configured to monitor* for an incorrectly performed action among a set of *sequential actions*.

316. Green discloses that its "tag sensor 32" "may scan/read each electronically identifiable tag 24" embedded in "each ply" "to detect the identification and position of the ply." [Green ¶¶ [0018], [0021], [0023].] "Tag sensor 32" transmits data regarding the identification and position of the ply "to the computer system 36 to confirm that each ply is being placed in a proper layup sequence and orientation." [Green ¶ [0023].] "If an incorrect one of the plies is selected or the ply that was placed on the layup table 30 is in an improper location and/or orientation, the computer system 36" may be configured to signal the error to the operator by "a flashing light and/or an audible alarm device), and/or to prevent subsequent displays by the laser projector 38." [Green ¶ [0023], Fig. 5 (56-60).] Green thus discloses that its *controller*, the computer system 36, is configured to monitor *operational*

information by monitoring for incorrectly performed actions. The information monitored by computer system 36 also includes whether the "ply is being placed in a proper layup sequence," and thus is *associated with sequential actions.* [Green ¶ [0023].]

317. Thus, Green anticipates claim 11.

8. Claim 12 Analysis

[12.0] The operational guide system of claim 11,

318. As explained above, Green anticipates the operational guide system of claim 11.

[12.1] said operational information including at least one selected from the group consisting of a cycle time, an incorrectly performed action, a time between sequential actions, and an operator identification.

319. Green discloses operational information[that] include[es] at least one selected from the group consisting of a cycle time, an incorrectly performed action, a time between sequential actions, and an operator identification.

320. As explained with regard to [11.1] above, computer system 36 monitors *operational information* consisting of "whether the identification and location of the ply detected … is correct." [Green ¶ [0025].] By determining whether the operator has placed the correct ply in the correct location, Green's computer system 36 monitors whether the operator has *incorrectly performed [an] action.*

321. Thus, Green anticipates claim 12.

E. Challenge 2B: Claims 7 and 13-25 are rendered obvious by the combination of Green and Kaufman

1. Rationale for combining Green and Kaufman

322. It would have been obvious to a POSITA to combine Green and Kaufman (Ex. 1008, U.S. Patent No. 6,547,397).

323. First, Green and Kaufman disclose similar systems that both use laser projectors to guide a human operator to perform an assembly process. [Green ¶ [0025], Kaufman at 1:20-26.] Both Green and Kaufman are analogous art to the '981 patent because they are directed to the same field of interactive computer applications (particularly to applications that project instructions to operators to aid them in completing a task). Both references are also reasonably pertinent to the same problem as the '981 patent, i.e. to guide human operators in assembly tasks, such as by projected light. ['981 patent at 1:16-19.]

324. Second, the Green-Kaufman combination is obvious because Green contains an express reference to an "overhead laser projection system" that is "commercially available from Laser Projection Technologies." [Green ¶ [0006].] According to the USPTO patent database, at the time Green was filed (August 3, 2005), Kaufman was the only issued U.S. Patent assigned to Laser Projection Technologies. [Ex. 1027.] Thus, a POSITA

considering Green would have looked to Kaufman for information regarding how to implement Green using the off-the-shelf commercial laser projector technologies mentioned in Green. This combination rationale applies to all of the claims described below. Moreover, based on the Laser Projection Technologies reference in Green, a POSITA would also have had a reasonable expectation of success in the combination.

325. Third, Green discloses using a Laser Projection Technologies system such as described in Kaufman "to verify that each ply in a layup has been placed in a proper position and orientation, and in a proper sequence." [Green ¶ [0006].] Green also explains that it was intended to improve upon the prior art. [Green ¶ [0007].] Thus, a POSITA would have understood that the system in Green was intended to be a modification to existing the laser projection assembly techniques, and that it was intended to be combined with the techniques from commercially available systems (such as from Kaufman / Laster Projection Technologies) using software interfaces to specify (or edit) information about the part to be laid up, including the "proper" position, orientation, and sequence of plies. Doing so would have been nothing more than improving a similar device (Kaufman) in the same way (adding Green's verification steps to Kaufman's existing system). Further, market forces, including the need to streamline the control and

configuration of manufacturing systems, would have also led a POSITA to implement Green using the teachings in Kaufman for the user interfaces.

326. Fourth, a POSITA would have been motivated to combine Green with Kaufman's display device (display 10) and operator interface displayable thereon. Green requires a display device connected to computer system 36. Green discloses that "computer system 36 may be programmed to display a warning to the operator to correct the position and/or orientation of the ply." [Green ¶ [0023].] Computer system 36 may also "display an error message to the operator" when "the identification and location of the ply … is not correct." [Green ¶ [0025].] The computer system also "direct[s]" an operator "to select a first ply, such as the ply 22j, and to place it on the layup table 30." [Green ¶ [0023].]

327. To the extent Green's computer system 36 does not include a display device such as a computer monitor, a POSITA would have been motivated to combine Green with Kaufman's display 10 (a computer monitor) and operator interface.

328. A POSITA would have a design incentive to add a display (to the extent one is not already present as part of computer system 36) because it improves the operator's user experience. Without a monitor, Green's computer system 36 is forced to display all error messages, warnings, and ply information using

laser projector 38. A POSITA would recognize that this limits the types of messages that can be conveyed, because laser projectors cannot display text and images with as much clarity and versatility as computer monitors. Furthermore, pro-longed exposure to laser projection can cause operator eye fatigue and can create hazards from accidental projection of the laser beam into an operator's eyes. [*See* Poggi, 1:39-44.] Adding Kaufman's display 10 and operator interface to Green would be nothing more than applying a known technique to a system ready for improvement to achieve the predictable result of a safer and more effective user interface.

329. A POSITA would also understand that Green's computer system 36 requires a graphical user interface, such as Kaufman's operator interface, to display images and text. This would have been nothing more than improving similar devices (Green and Kaufman) in the same way (implementing graphical user interface.)

330. Lastly, a POSITA would have recognized that modifying Green's computer system 36 to receive manual confirmation of the completion of a ply layer placement would have signaled to the system when to read the electronically identifiable tags to determine whether the plies had been placed correctly. [*See* Green ¶ [0025] (describes the operator locating the ply on the layup table before "[n]ext, the computer system 36 and the tag sensors 32 may be

used to detect the identification and position of the ply.")] This would have various benefits, including conserving computing resources by eliminating the need for the system to constantly monitor for the ply and evaluate whether the ply is in the correct location. Without Kaufman's manual signal, the system disclosed in Green might have simply monitored the entire workspace at all times, potentially creating false-positive error signals while the operator was still working to place the ply correctly. Furthermore, because Kaufman discloses the "layers are marked or unmarked as complete at Step 1276 by the operator simply clicking on a particular layer," [Kaufman, 15:36-38], adding this version of Kaufman's manual confirmation also renders obvious adding its display 10 to Green. Adding Kaufman to Green in this way would be nothing more than applying a known technique (Kaufman's manual confirmation functionality) to a system (Green) ready for improvement to achieve a predictable result of increased system efficiency and accuracy.

2. Claim 7 Analysis

[7.0] The operational guide system of claim 1,

As explained in Challenge 2A above, Green anticipates *the operational guide system of claim 1*.

[7.1] wherein said controller is adapted to receive at least one confirmation signal indicative of a completion of an assembly action, said at least one confirmation signal comprising at least one signal selected from the group consisting of a manually input signal and an automated input signal.

331. Green in view of Kaufman renders obvious a *controller [that] is adapted to receive at least one confirmation signal indicative of a completion of an assembly action, said at least one confirmation signal comprising at least one signal selected from the group consisting of a manually input signal and an automated input signal.*

332. Kaufman discloses functionality that enables its operator to manually mark assembly layers "as complete" by "clicking on a particular layer." [Kaufman, 15:36-38.] By "clicking on a particular layer" to mark it "complete," Kaufman's operator program receives a *manually input confirmation signal indicative of a completion of an assembly action.* [Kaufman, 15:36-38.] As discussed above with respect to claim 1, Green uses a *sensor apparatus* (tag sensor 32) and *controller* (computer system 36) to determine when a ply has been placed on a layup table. [Green ¶ [0023].] Because Green's plies are sequentially laid up to assemble a composite panel, when Green's system determines when a ply has been placed on the layup table, it determines whether an assembly action has been completed.

333. In the Green-Kaufman combination, Green's computer system 36 would be modified based on the teachings of Kaufman to enable an operator to input a manual confirmation signal to computer system 36 when the operator has placed the current ply in the correct location and orientation. This Green-Kaufman combination *controller [would be] adapted to receive at least one confirmation signal indicative of a completion of an assembly action* when the operator confirmed the placement of a ply (i.e., generating a *manually input signal*).

334. Thus, the Green-Kaufman combination renders obvious claim 7.

3. Claim 9 Analysis

[9.0] "The operational guide system of claim 1,"

335. As explained in Challenge 2A above, Green anticipates *the operational guide system of claim 1*.

[9.1 – 9.2]: "further including a display device, and wherein said controller is programmable via at least one program screen displayable on said display device, said at least one program screen configured to include at least one input field for entering and/or selecting indicia regarding sequential actions; said controller being further configured to display at least one display screen on said display device during operation of said operational guide system, said display screen being adapted to display indicia regarding sequential actions to be performed."

336. As explained in Challenge 1B above, Kaufman discloses the limitations of claim 9. Additionally, as explained above in Section XI.E.1, it would have

been obvious to combine the laser projection control techniques of Kaufman with Green, including the *display device* (display 10) and Kaufman's administrator screen (which permits programming of the system).

337. Thus, the Green-Kaufman combination renders claim 9 obvious.

4. Claim 10 Analysis

[10.0]: "The operational guide system of claim 9,"

338. As explained above, the Green-Kaufman combination renders obvious *the operational guide system of claim 9*.

[10.1 – 10.2]: "wherein said at least one input field comprises at least one selected from the group consisting of a description field, a graphic field, and a location field, and wherein said description field is configured to enable programming of descriptive text associated with sequential actions, said graphic selection field is configured to enable programming of an image formed by said at least one indicating light, and said location field is configured to enable programming of the location at which said at least one directional light device projects said at least one indicating light."

339. As explained in Challenge 1B above, Kaufman discloses the limitations of claim 10. Additionally, as explained above in Section XI.E.1, it would have been obvious to combine the laser projection control techniques of Kaufman with Green.

340. Thus, the Green-Kaufman combination renders claim 10 obvious.

5. Claim 13 Analysis

[13.0] The operational guide system of claim 1,

341. As explained in Challenge 2A above, Green anticipates *the operational guide system of claim 1*.

[13.1] further including a display device, said display device being operable to display information regarding sequential actions.

342. Kaufman discloses *a display device, said display device being operable to display information regarding sequential actions.*

343. As discussed above in Challenge 1B at [9.0] - [9.1] and in the combination rationale for this challenge, Kaufman discloses a *display device* (display 10) operable to display information from an operator program. Kaufman teaches "[t]he operator program allows an operator to use the 3-D projection system to project templates onto work pieces." [Kaufman, 9:53-54.] Among other things, the operator program allows an operator to select a "job" (or a set of assembly tasks) he or she wishes to perform, [Kaufman, 12:63-64], displays images of layers that make up a part to be assembled, [Kaufman, 15:6-11], and projects the images using a projector. [Kaufman, 15:16-18.] Because each of the images shows "the desired location of a ply on previously placed plies," [Kaufman, 1:24-26], Kaufman's display 10 is *operable to display*

information (e.g. images of layers) *regarding sequential actions* (placing layers or plies in a layup sequence.)

344. The reasons for the Green-Kaufman combination are described above. Thus, the Green-Kaufman combination renders claims 13 obvious.

6. Claim 14 Analysis

[14.0] A method for guiding assembly actions by providing visual indicators, said method comprising:

345. As explained above in Challenge 2A with regard to [1.0], Green discloses a system and *method for guiding assembly actions by providing visual indicators*.

[14.1] identifying a characteristic of a work piece requiring assembly actions;

346. As explained in Challenge 2A above, Green's "tag sensor 32" "may scan/read each electronically identifiable tag 24 in … each ply," and each tag is associated "with a part number and a ply number." [Green ¶¶ [0023] – [0024].] By identifying the part number and ply number of the ply Green discloses *identifying a characteristic of a work piece requiring assembly actions*.

347. Thus, Green discloses [14.1].

[14.2] communicating identification information to a controller in response to the identifying of a characteristic of the work piece;

348. As explained with regard to [1.1] – [1.2] in Challenge 2A above, after "tag sensor 32" "scan[s]/read[s] each electronically identifiable tag 24 in the each ply" it "transmit[s] appropriate data" to computer system 36, which is a *controller*. [Green ¶ [0023].] The computer system 36 uses the "appropriate data" transmitted from tag sensor 32 to determine "the identification and position of the ply." [Green ¶ [0025].] Thus, Green teaches *communicating identification information* from the identifiable tag 24 to computer system 36—*a controller*. The identification information is *communic[ated] in response to the identifying of a characteristic of the work piece* because it occurs in response to tag sensor 32 detecting a tag.

349. Thus, Green discloses [14.2].

[14.3] communicating a first command signal to at least one directional light device in response to the identifying of a characteristic;

350. Green discloses [14.3] for the reasons explained with regard to [1.2] in Challenge 2A above.

351. Because the '981 patent discloses *operation information* and *characteristics* both includes "the presence and/or type of [a] work piece", ['981 patent, 5:35-42], the *operation information* used to determine whether to send a

command signal as discussed above at [1.2] in Challenge 2A (i.e., the presence and identity of a tag) is also the *characteristic* in [14.1]-[14.3]. Thus, Green discloses *communicating a first command signal to at least one directional light device in response to the identifying of a characteristic* for the same reasons discussed above for [1.2]. Thus, Green discloses [14.3].

[14.4] selectively projecting at least one indicating light via the directional light device in response to the first command signal; and

352. As explained with regard to [1.3] in Challenge 2A above, Green discloses *selectively projecting at least one indicating light via the directional light device in response to the first command signal.*

[14.5] communicating a confirmation signal to the controller upon completion of a first operation step.

353. As explained with regard to [7.1] above, the Green-Kaufman combination renders this element obvious. Claim 14's *operation step* corresponds to claim 7's *assembly action*. ['981 patent at 2:20-22 (explaining that an assembly action is an example of an operation step.)]

354. Thus, the Green-Kaufman combination discloses [14.5] and renders claim 14 obvious.

7. Claim 15 Analysis

[15.0] "The method of claim 14,"

355. As explained above, the Green-Kaufman combination renders obvious *the method of claim 14*.

[15.1]: "wherein identifying a characteristic of a work piece comprises identifying the presence of a work piece with a sensor apparatus."

356. As explained with regard to [4.1] in Challenge 2A above, Green discloses *identifying a characteristic of a work piece compris[ing] identifying the presence of a work piece with a sensor apparatus.*

357. Thus, the Green-Kaufman combination renders claim 15 obvious.

8. Claim 16 Analysis

[16.0] "The method of claim 15,"

358. As explained above, the Green-Kaufman combination renders obvious *the method of claim 15*.

[16.1]: "including identifying the type of work piece requiring assembly actions."

359. As explained with regard to [5.1] in Challenge 2A above, Green discloses *identifying the type of work piece requiring assembly actions.*

360. Thus, the Green-Kaufman combination renders claim 16 obvious.

9. Claim 17 Analysis

[17.0] "The method of claim 14,"

361. As explained above, the Green-Kaufman combination renders obvious *the method of claim 14*.

[17.1]: "wherein projecting at least one indicating light comprises projecting at least one indicating light toward at least one of a component location and an operation step location."

362. Green discloses wherein projecting *at least one indicating light comprises projecting at least one indicating light toward at least one of a component location and an operation step location.*

363. As explained with regard to [6.1] in Challenge 2A above, Green discloses that its "laser projector 38 may be used to project an outline showing the proper positioning of a ply on the layup table 30." [Green ¶ [0025].] "If the identification and location of the ply detected at 54 is correct, the computer system 36 and laser projector 38 display a laser projected outline for the next ply." [Green ¶ [0025].] Thus, Green discloses *projecting at least one indicating light* (laser outline) *toward an operation step location* (the "proper positioning of a ply"). [Green ¶ [0025].]

364. Thus, the Green-Kaufman combination renders claim 17 obvious.

10. Claim 18 Analysis

[18.0] The method of claim 14,

365. As explained above, the Green-Kaufman combination renders obvious *the method of claim 14*.

[18.1] wherein projecting at least one indicating light comprises projecting at least one indicating light in a selectively configurable pattern.

366. As explained in Challenge 1B above, Kaufman discloses the limitations of claim 18. Additionally, as explained above in Section XI.E.1, it would have been obvious to combine the laser projection control techniques of Kaufman with Green.

367. Thus, the Green-Kaufman combination renders claim 18 obvious.

11. Claim 19 Analysis

[19.0] "The method of claim 14,"

368. As explained above, the Green-Kaufman combination renders obvious *the method of claim 14*.

[19.1]: "wherein communicating a confirmation signal comprises communicating a confirmation signal from at least one selected from the group consisting of a manual input signal and an automated input signal."

369. As explained with regard to [7.1] above, Kaufman discloses this limitation. Additionally, as explained above in Section XI.E.1, it would have been

obvious to combine the laser projection control techniques of Kaufman with Green.

370. Thus, the Green-Kaufman combination renders claim 19 obvious.

12. Claim 20 Analysis

[20.0] "The method of claim 14, including"

371. As explained above, the Green-Kaufman combination renders obvious *the method of claim 14*.

[20.1]: "communicating a second command signal from the controller to the at least one directional light device in response to the confirmation signal;"

372. As discussed above for [7.1] and [14.5], the Green-Kaufman combination renders obvious an operator inputting a *confirmation signal* after a ply is placed. In the Green-Kaufman combination, this *confirmation signal* causes Green's computer system 36 and tag sensor 32 to read the tags attached to the plies, and determine whether the correct ply is placed in the correct location. [Green ¶¶ [0024], [0025].] "If the identification and location of the ply detected at 54 is correct, the computer system 36 and laser projector 38 display a laser projected outline for the next ply, as indicated at 58." [Green ¶ [0025], Fig. 5 (56-58).] As explained with regard to [1.3] in Challenge 2A above, Green's computer system 36 (a *controller*) sends a *command signal to* laser projector 38 (a *directional light device*). Thus,

Green's disclosure that "computer system 36 and laser projector 38 display a laser projected outline for the next ply," [Green ¶ [0025]], discloses the claimed *second command signal* sent *in response to the confirmation signal* (i.e., the manual signal from the operator as disclosed in Kaufman).

373. Thus, the Green-Kaufman combination renders obvious [20.1].

[20.2]: "projecting at least one indicating light from the directional light device in response to the second command signal; and"

374. For the same reasons explained with regard to the command signal of [1.3], Green's laser projector 38 displays an outline of the next ply in response to the *second command signal* of [20.1].

375. Thus, the Green-Kaufman combination renders obvious [20.2].

[20.3]: "communicating a confirmation signal to the controller upon completion of a second operation step."

376. As explained above with regard to [7.1], [14.5], and Section XI.E.1, the Green-Kaufman combination discloses a *confirmation signal* (the confirmation signal produced when the operator indicates that a ply layer is complete) that is communicated to *the controller* (computer system 36) after a ply is added to the composite panel for computer system 36 and tag sensors 32 to verify that the ply had been correctly placed. Because Green discloses repeating this verification process for each ply added to the composite panel, [Green, ¶ [0025], Fig. 5 (56)], a confirmation signal would

therefore be sent for each ply (including *upon completion of a second operation step*).

377. Thus, the Green-Kaufman combination renders obvious [20.3] and claim 20.

13. Claim 21 Analysis

[21.0] "The method of claim 20, including"

378. As explained above, the Green-Kaufman combination renders obvious *the method of claim 20*.

[21.1]: "repeating said communicating a command signal; projecting at least one indicating light in response to said command signal; and communicating a confirmation signal until assembly actions for the work piece have been completed."

379. The Green-Kaufman combination renders obvious a repeating said communicating a command signal; projecting at least one indicating light in response to said command signal; and communicating a confirmation signal until assembly actions for the work piece have been completed.

380. Green repeats the process of using laser projector 38 to display ply outlines for each ply in the assembly sequence. [Green ¶¶ [0023], [0025], FIG. 5.] Based on the disclosures in Green that its system and method are for the assembly of a "composite panel" via "ply layup," [Green, Abstract], it would have been obvious to a POSITA that each part of Green's ply layup process is repeated for each ply until the composite panel had been assembled. Thus, the process performed in the Green-Kaufman combination described

above for claims 1, 7, 14, 19, and 20 renders obvious *repeating* the claimed method steps *until assembly actions for the work piece have been completed*

381. Thus, the Green-Kaufman combination renders claim 21 obvious.

14. Claim 22 Analysis

[22.0] "The method of claim 14, including:"

382. As explained above, the Green-Kaufman combination renders obvious *the method of claim 14*.

[22.1 – 22.2] "programming the controller via at least one program screen displayable on the display device, the at least one program screen configured to include at least one input field for entering and/or selecting indicia regarding sequential actions; and displaying indicia regarding sequential actions to be performed on at least one display screen displayable on the display device."

383. As explained in Challenge 1B above, Kaufman discloses the limitations of claim 22. Additionally, as explained above in Section XI.E.1, it would have been obvious to combine the laser projection control techniques of Kaufman with Green.

384. Thus, the Green-Kaufman combination renders claim 22 obvious.

15. Claim 23 Analysis

[23.0] "The method of claim 14, including:"

385. As explained above, the Green-Kaufman combination renders obvious *the method of claim 14*.

[23.1]: "monitoring operational information associated with sequential actions via the controller."

386. As explained with regard to [11.1] in Challenge 2A above, Green discloses monitoring operational information associated with sequential actions via the controller.

387. Thus, the Green-Kaufman combination renders claim 23 obvious.

16. Claim 24 Analysis

[24.0] "The operational guide system of claim 2,"

388. As explained in Challenge 2A above, Green anticipates *the operational guide system of claim 2*.

[24.1 – 24.2] further including a display device, and wherein said controller is programmable via at least one program screen displayable on said display device, said at least one program screen configured to include at least one input field for entering and/or selecting indicia regarding sequential actions; said controller being further configured to display at least one display screen on said display device during operation of said operational guide system, said display screen being adapted to display indicia regarding sequential actions to be performed.

389. For the same reasons explained with regard to claims 9 – 10 in Challenge 1B above, Kaufman discloses [24.1 – 24.2]. Additionally, as explained above in Section XI.E.1, it would have been obvious to combine the laser projection control techniques of Kaufman with Green. The fact that claim 24 depends from claim 2 is immaterial to a POSITA's motivation to combine Green

with Kaufman because both references concern using a laser projector to guide performance of an assembly action.

390. Thus, the Green-Kaufman combination renders obvious claim 24.

17. Claim 25 Analysis

[25.0] The operational guide system of claim 2,

391. As explained above in Challenge 2A, Green anticipates *the operational guide system of claim 2*.

[25.1] further including a display device, said display device being operable to display information regarding sequential actions.

392. As explained above with regard to [13.1], Kaufman discloses *a display device, said display device being operable to display information regarding sequential actions.*

393. Thus, the Green-Kaufman combination renders claim 25 obvious.

F. Challenge 2C: Claim 3 is obvious over Green in view of Pinhanez

1. Rationale for combining Green and Pinhanez

394. Pinhanez (Ex. 1009) is discussed above for Challenge 1C. Among other things, Pinhanez discloses highlighting a component location using a projector. [Pinhanez at 3, Pinhanez at Fig. 2(b).] It would have been obvious to a POSITA to combine Green with Pinhanez such that (1) Green's plies were organized in pre-programmed locations (just as Pinhanez's

bucket's are so organized) and (2) so that Green's system would highlight a component location. Such a modification would improve Green's similar projection system in the same way as Pinhanez. Furthermore, Green and Pinhanez disclose analogous systems to that of the '981 patent because both concern interactive computer applications, especially those that project instructions to operators to aid them in completing a task. [Green ¶ [0025]; Pinhanez, 2-3.] Green and Pinhanez are both reasonably pertinent to the problem to which the '981 patent was directed, or how to guide human operators in assembly tasks, including by projected light. ['981 patent, 1:16-19.]

395. Highlighting the location where each ply is stored in Green would have been both obvious and helpful. The modification would assist the operator and reduce the amount of time to find the correct ply, in the same way that highlighting the storage bucket with M&M's of the selected color in Pinhanez assists the user in retrieving items from the correct storage bucket. A POSITA also would have had a reasonable expectation of success in this combination because it would be nothing more than using known technology (the system already developed in Pinhanez) in a similar system (Green). Similarly, the combination of Green and Pinhanez is the application of a known technique (Pinhanez's supply-location-highlighting method) to a

known device (Green) ready for improvement to yield predictable results of faster and more accurate retrieval of components. Market forces including the need to decrease assembly time would also have led a POSITA to combine Green with the teachings in Pinhanez.

2. Claim 3 Analysis

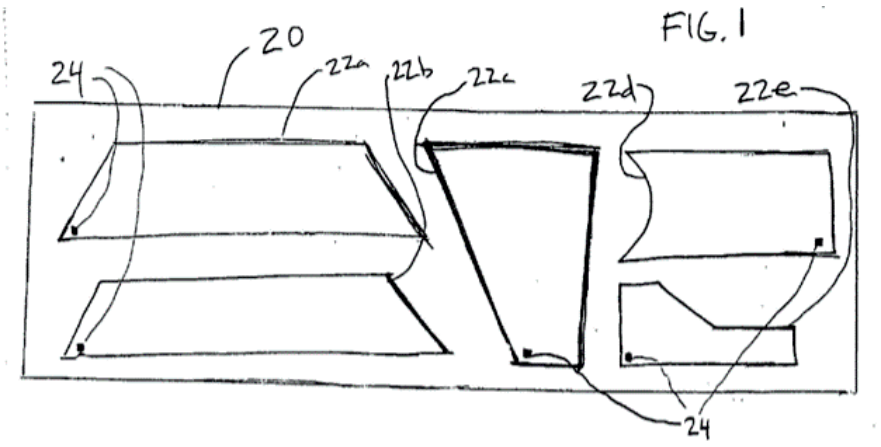
[3.0] "The operational guide system of claim 2,"

396. As explained in Challenge 2A above, Green anticipates *the operational guide system of claim 2*.

[3.1]: "wherein said at least one indicating light is projected at a component location, said component location retaining a part required for assembly at said work station."

397. As described with regard to [3.1] in Challenge 1C above, Pinhanez discloses projecting at least one indicating light at a component location, said component location retaining a part required for assembly at said work station.

398. Additionally, as shown in Figure 1 below, Green discloses "a ply cutter bed" that contains "cut plies" for use in Green's ply layup operation. [Green ¶ [0013], FIG. 1.] Such an organized layout would make it simple for Green's system to identify which plies were needed next.



Green, FIG. 1.

399. It also would have been obvious to use one of Green's sensors to identify which ply to pull from the ply cutter bed. Green further discloses that its system instructs an operator to "select a first ply, such as the ply 22*j*." [Green ¶ [0023].]

400. A POSITA would have recognized that Green could be modified based on the teachings of Pinhanez to include light projection that would indicate to the operator which ply (*part[s] required for assembly at said work station*) on the ply cutter bed (*component location*) is needed next.

401. Thus, the combination of Green with Pinhanez renders obvious claim 3.

* * *

402. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

403. I declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

404. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Date: November 4, 2023

By: 

William Singhose