

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

THE HILLMAN GROUP, INC.,
Petitioner

v.

HY-KO PRODUCTS COMPANY LLC,
Patent Owner

Case IPR2023-00075
Patent No. 9,514,385

DECLARATION OF SCOTT BASHAM

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 - d. 1[c] one or more mirrors positioned to allow said camera to capture two or more views of the master key wherein said characteristics of said contour are determined based on image data from at least said two or more views of said master key wherein at least one said view is substantially a tip end view, and wherein said logic calculates the geometry of the contour based on data from at least said two or more views of said master key.43
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I, Scott Basham, of Chandler, Arizona, declare that:

I. INTRODUCTION

1. My name is Scott Basham, and I have been retained by counsel for Petitioner, The Hillman Group, Inc., as an expert witness to provide assistance regarding U.S. Patent No. 9,514,385 (“the ’385 patent”). Specifically, I have been asked to consider the validity of claims 1-7, 9-11, 13-18, and 20-26 of the ’385 patent (the “challenged claims”) in view of prior art, anticipation and obviousness considerations, and the understanding of a person of ordinary skill in the art at the time of the invention (“POSA”) as it relates to the ’385 patent. I have personal knowledge of the facts and opinions set forth in this declaration and believe them to be true. If called upon to do so, I would testify competently thereto.

2. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my opinions, or the outcome of any proceeding involving the challenged claims. I have no financial interest in the outcome of this matter or in the pending litigation between Petitioner and Patent Owner.

3. My analysis here is based on my years of education, research and experience, as well as my investigation and study of relevant materials, including those cited herein.

4. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

5. My analysis of the materials in this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

II. BACKGROUND AND QUALIFICATIONS

6. I am an expert in the field of key duplication equipment. I believe that I am well qualified to serve as a technical expert in this matter based upon my qualifications, discussed in detail below. A copy of my curriculum vitae is provided as Ex. 1004.

7. Based on my education and work experience, I am knowledgeable about the subject matter of the '385 patent and the related prior art. Specifically, my qualifications as an expert in the field of key duplication equipment, and other similar machines, stem from my nearly twenty-two years of work experience at The Hillman Group, Inc. ("Hillman") and my prior employment working in electrical and mechanical control systems, as well as my education in electronic engineering

technology. I am a co-inventor of ten patents pertaining to key duplication and related technologies.

8. I received a B.S. in Electronic Engineering Technology from the DeVry Institute of Technology in 1985. From then to 1987, I was employed as an engineer and production manager at Sensor Technology, where I designed microprocessor-based controllers for industrial process control. Then, from 1988 to 1994, I worked as an engineering manager at DH Instruments, where I designed, among other things, high accuracy pressure controllers, flow meters, and standards; microprocessor-based instruments; and analog interface circuitry. From 1994 to 1998, I was employed at Kroy Incorporated as an electronic engineer, where I worked to develop thermal printers and related hardware and software. My work at Sensor Technology, DH Instruments, and Kroy Incorporated all involved the development of mechanical and electrical control systems employing many of the techniques applicable to key duplication machines.

9. In 1998, I joined Hillman as a manufacturing engineer. In that role, I worked to design and implement machines for engraving metal tags for pets. This work drew on my experience in mechanical and electrical control systems. Further, the design of these machines required consideration of challenges that would arise again for key duplication, including mechanical solutions for supporting and/or stabilizing the tag in the machine.

10. From 2000 to 2014, I worked as the Director of Engineering at Hillman.

In this role, I guided product innovation, design, and improvement for not only tag engraving machines but also key duplication machines. In this role, I developed a comprehensive knowledge of key duplication technology, including the various considerations at play, the technological challenges faced, and the solutions to these technological challenges. For example, I became familiar with the wide variation in keys. I designed the machines at Hillman to work with numerous types of keys, including keys of differing materials or paints, single-sided keys, double-sided keys, shoulder-gage keys, tip-gage keys, and rubberized keys. In designing these machines, I also accounted for variations in keys made by different manufacturers as well as the variations in keys that result from wear and tear, such as bending, warping, breakage, and/or alteration in the blade and/or milling, that results from use. In my work, I designed key duplication machines to address these variations by recognizing how the key duplication machines would need to account for them.

11. The key duplication machines I designed and implemented at Hillman employed various techniques for key identification, that is, the process by which an appropriate key blank is selected to duplicate a master key. I worked to design and implement machines that employed both mechanical and optical techniques for extracting key information from master keys, including techniques for using cameras, mirrors, shields, lasers, LEDs, drawers, doors, and clamps. Many techniques I used

involved the extraction of information about millings on master keys, including the size, shape, depth, and length of the millings, as this information was valuable in identifying a key blank with which to duplicate a master key. In designing key identification systems, I sought to accommodate the variations among master keys, such as by ensuring a selected imaging technique would work with keys of different materials or altered by wear and tear. The machines I designed and implemented while working at Hillman included both machines in which the master key was laid upon a surface and machines in which the master key was secured using a clamp.

12. The key duplication machines I designed and implemented while working at Hillman also employed various techniques for key cutting, that is, the process by which a key blank, once identified, is cut to duplicate the master key. In this work, I drew on my prior experience in mechanical and electrical control signals to design systems.

13. I retired from Hillman in 2020 and am no longer an employee at Hillman. Since my retirement, I have been engaged in consulting and contracting with several companies, including work involving industrial controls for a recreational vehicle company and work involving automotive keys and transponders. I have also spent time remodeling homes and working on my golf game. I was retained by counsel for Petitioner in this matter in 2022.

III. LEVEL OF ORDINARY SKILL IN THE ART

14. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a person of ordinary skill in the art (“POSA”) at the time of the alleged invention, which I understand is asserted to be as early as May 1, 2009. I understand that determining the ordinary skill in the art includes looking, among other considerations, at (i) the type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) rapidity with which innovations are made; (iv) sophistication of the technology; and (v) educational level of active workers in the field. I understand that a POSA is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a POSA would also have knowledge from the teachings of the prior art, including the art cited below.

15. Taking these factors into consideration, on or before May 1, 2009, a POSA of the ’385 patent would have had a degree in engineering and three years of experience in key duplication equipment. This level of skill is approximate, and more experience would compensate for less formal education, and vice versa. For example, an individual having no degree in engineering, but ten years of key duplication experience would qualify as a POSA. Moreover, a person with no key duplication experience but a masters or doctorate in engineering may also qualify as a POSA. The experience in the field of key duplication equipment may include

experience with various types of key duplication equipment, including vending machines. Additional education could substitute for professional experience and vice versa.

16. Before May 1, 2009, my level of skill in the art was at least that of a POSA. I am qualified to provide opinions concerning what a POSA would have known and understood at that time, and my analysis and conclusions herein are from the perspective of a POSA as of that date.

IV. MATERIALS CONSIDERED AND RELIED UPON

17. In reaching the conclusions described in this declaration, I have relied on the documents and materials cited herein as well as those identified in this declaration, including the '385 patent, the prosecution history of the '385 patent, and prior art references cited herein. These materials comprise patents, related documents, and printed publications. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions.

18. In quoting the cited references, all emphasis is added unless otherwise noted.

19. I have also relied on my education, training, research, knowledge, and personal and professional experience in the relevant technologies and systems that were already in use prior to, and within the timeframe of the earliest asserted

invention date of the claimed subject matter in the '385 Patent, which is May 1, 2009.

- Ex. 1001:** U.S. Patent No. 9,514,385 (“the ’385 patent”)
- Ex. 1002:** Prosecution History of U.S. Patent No. 9,514,385
- Ex. 1005:** U.S. Patent No. 6,064,747 to Wills et al. (“*Wills*”)
- Ex. 1006:** U.S. Patent App. Pub. No. 2007/0224008 to Bass et al. (“*Bass*”)
- Ex. 1007:** U.S. Patent App. Pub. No. 2007/0233298 to Heide et al. (“*Heide*”)
- Ex. 1008:** U.S. Patent No. 9,934,448
- Ex. 1009:** U.S. Patent No. 11,227,181
- Ex. 1010:** Prosecution History of U.S. Patent App. Serial No. 15/920,955
- Ex. 1011:** U.S. Patent No. 8,644,619
- Ex. 1012:** Prosecution History of U.S. Patent App. Serial No. 12/722,709
- Ex. 1013:** U.S. Patent No. 4,899,391 to Cimino et al. (“*Cimino*”)
- Ex. 1014:** U.S. Patent Publication No. 2003/0072011 to Shirley (“*Shirley*”)

V. LEGAL STANDARDS

20. 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 and my reading of the documents submitted in this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the challenged claims.

A. Claim Construction

21. I have been instructed that the terms appearing in the '385 patent should be interpreted in view of the claim language itself, the specification, the prosecution history of the patent, and any relevant extrinsic evidence. The words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have to a POSA at the time of the invention, which I have assumed

here is May 1, 2009. While claim limitations cannot be read in from the specification, the specification is the single best guide to the meaning of a disputed term. I have followed these principles in reviewing the claims of the '385 patent and forming the opinions set forth in this declaration.

22. I understand that there is a special category of claim terms, known as “means-plus-function” terms that recite a structural component solely in terms of the function it performs. In other words, a patent claim may recite a structural element that is essentially a placeholder word (for example, the word “means”) presented in terms of the function it performs (e.g., a claim reciting a “means for [function]”). I have been told that construing means-plus-function terms involves two steps: (1) identifying the claimed function, and (2) determining what structure, if any, disclosed in the specification corresponds to that claimed function.

B. Anticipation

23. 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.

C. Obviousness

24. I understand that the existence of each and every element of the claimed

invention in a prior art does not necessarily prove obviousness and that most, if not all, inventions rely on building blocks of prior art. But I have been told that under 35 U.S.C. § 103, a patent claim may be 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 to a POSA to which said subject matter pertains at the time the invention was made. I have been told that a proper obviousness analysis requires the following:

- a. Determine the scope and content of the prior art;
- b. Ascertain the differences between the prior art and the claims at issue;
- c. Resolve the level of ordinary skill in the pertinent art; and
- d. Consider evidence of secondary indicia of non-obviousness (if available).

25. I have been told that the relevant time for considering whether a claim would have been obvious to a POSA is the time of invention. For my obviousness analysis, counsel for Petitioner instructed me to assume that the date of invention for the challenged claims is May 1, 2009, the filing date of the earliest provisional patent application to which the '385 patent claims priority. My opinions would not change if I assumed a later date of invention.

26. I have been told that a reference may be modified or combined with other references, or with a POSA's own knowledge, if the person would have found the modification or combination obvious. I have also been told that a POSA is

presumed to know all the relevant prior art, and the obviousness analysis may take into account the inferences and creative steps that a POSA would employ.

27. I have been told that whether a prior art reference renders a patent claim obvious is determined from the perspective of a POSA. I have also been told that, while there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, and while a suggestion 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 a POSA would employ, as filtered through the knowledge of one skilled in the art, 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.

28. 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 invention at issue is improper.

VI. OVERVIEW OF PRIOR ART

A. Wills

29. U.S. Patent No. 6,064,747 (Ex. 1005) (“*Wills*”) issued May 16, 2000. I understand *Wills* constitutes prior art under at least pre-AIA 35 U.S.C. §§ 102(a), 102(b), and/or 102(e).

30. *Wills* describes a “key regenerating machine in which [a] master key is optically analyzed” and “the appropriate key blank determined.” *Wills*, 1:7-10. According to *Wills*, by 2000 already “[i]t [was] well known in the art to duplicate keys, referred to as master keys, onto a key blank.” *Id.*, 1:13-14. *Wills*’s key regenerating machine is configured to “identify[] the type of key blank onto which the master key is to be reproduced.” *Id.*, 1:48-49.

31. A master key is illustrated in Figure 7A. *Wills*, 5:22-24. As shown, the master key includes a milling “ML,” which *Wills* describes as “a longitudinally-extending groove.” *Id.*, 5:56-59.

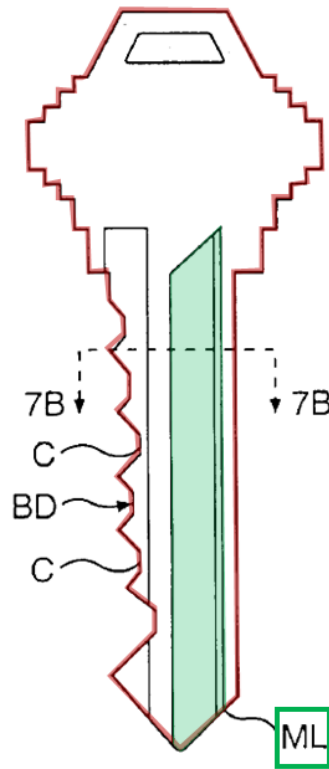


FIG. 7A

Wills, Figure 7A (annotated).

32. The **milling** of the **master key** in Figure 7A has particular “**surface information**,” such as a “**depth**,” as shown in Figure 7B, which is a cross-section of Figure 7A. *Wills*, 5:25-28, 5:61-65, 11:59-63.

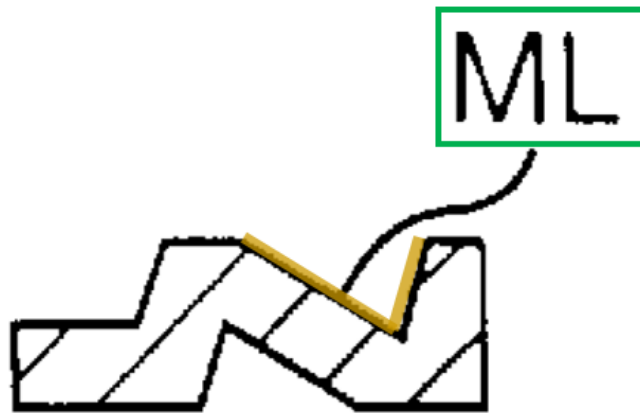


FIG. 7B

Wills, Figure 7B (annotated).

33. An embodiment of *Wills*'s machine is illustrated in Figure 8. As shown, the **master key** is placed in the machine, and a "laser line generator 39" is used to generate a light beam "LB" incident on the **master key** and, in particular, on the **milling** in a blade of the **master key**. *Id.*, 11:44-55. A "camera 28" captures an image "that is the result of the light beam interfacing with the surface of the **master key**." *Id.*, 11:59-63.

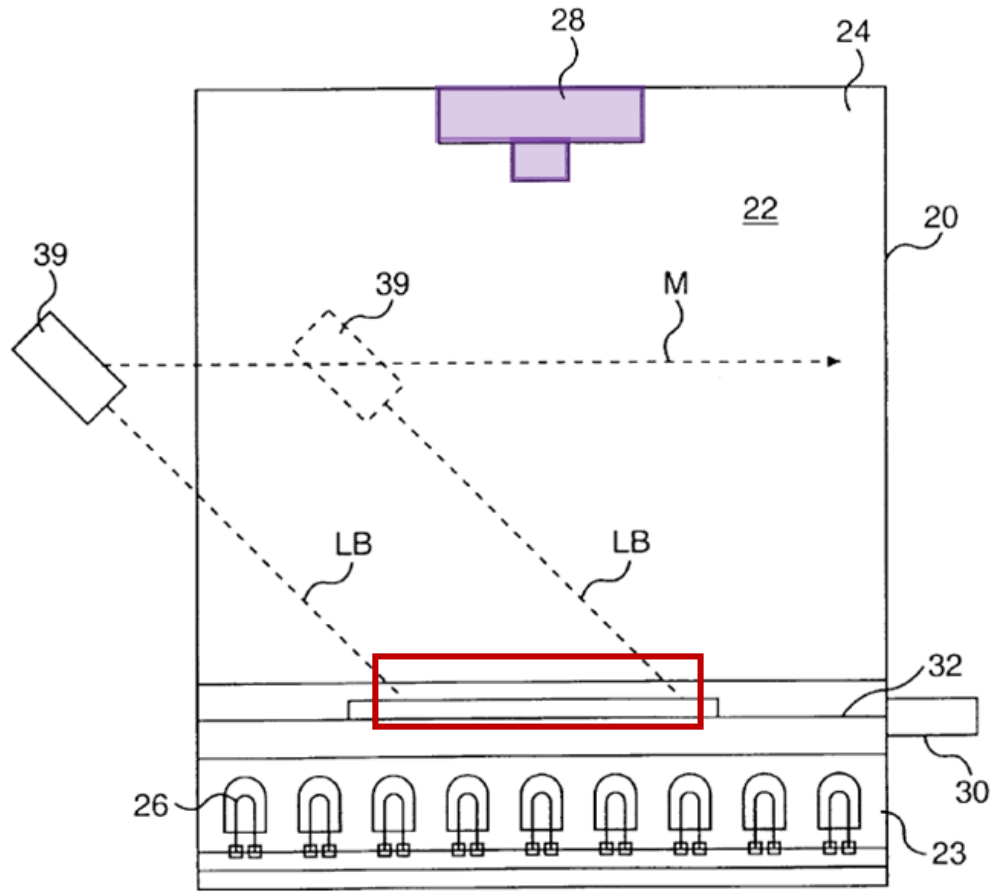
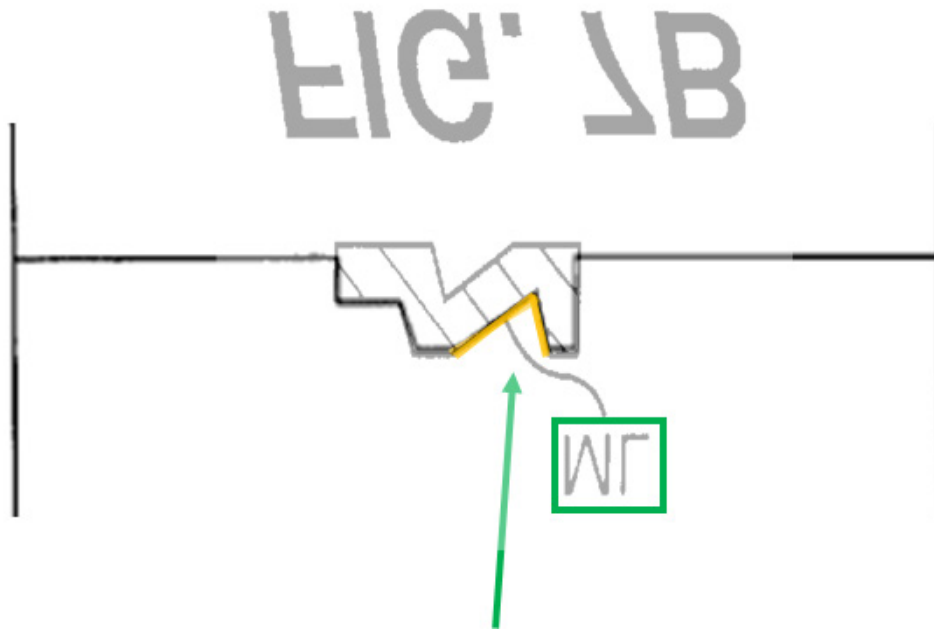


FIG. 8

Wills, Figure 8 (annotated).

34. As Figure 7D illustrates, the image captured by the camera “is the result of the light beam interfacing with the surface of the master key shown in FIG. 7A, specifically the surface shown in FIG. 7B.” *Wills*, 11:59-63. In particular, Figure 7B, which is a “*cross-sectional* view of FIG. 7A taken along line 7B—7B,” and Figure 7D, which shows “[t]he intersection of the light beam line and the key surface,” are vertically flipped relative to one another, as may be seen by vertically

flipping Figure 7B and superimposing it on Figure 7D, as shown below. *Id.*, 3:11-12, 3:16-17.



Wills, Figure 7D (cropped) and Figure 7B (annotated, vertically flipped, and superimposed on Figure 7D).

35. As shown, the image captured by the camera includes the “surface information” of the master key, including the “depth of [the] milling” in the blade.

Wills, 13:1-3.

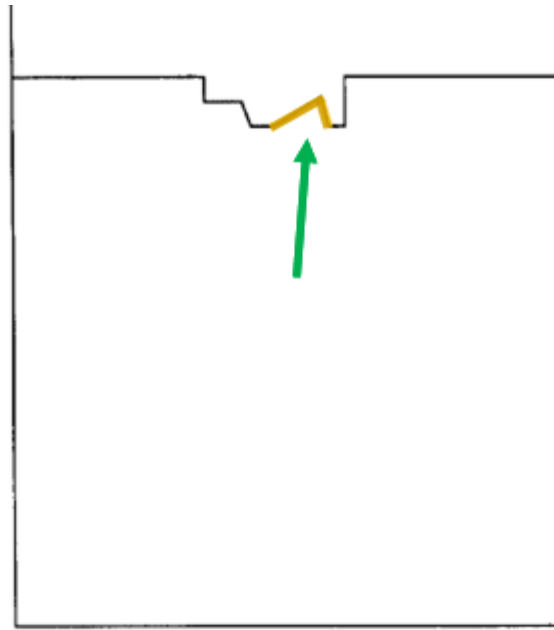


FIG. 7D

Wills, Figure 7D (cropped and annotated).

36. While Figure 7D shows only a “two-dimensional slice[]” of the master key, *Wills* envisions capturing “an entire three-dimensional surface image of the [master] key” by capturing two-dimensional slices “along the length of the key.” *Wills*, 15:34-42. As *Wills* explains with reference to Figure 8, “[a]s the light beam LB is swept along the length of the [master] key, illustrated by the second laser line generator 39 in phantom lines, a series of two-dimensional slices is generated,” and these “slices are stacked to form the entire three-dimensional representation of the key.” *Id.*, 15:40-50. This three-dimensional image includes the “depth of [the] milling across the [master] key.” *Id.*, 13:1-2.

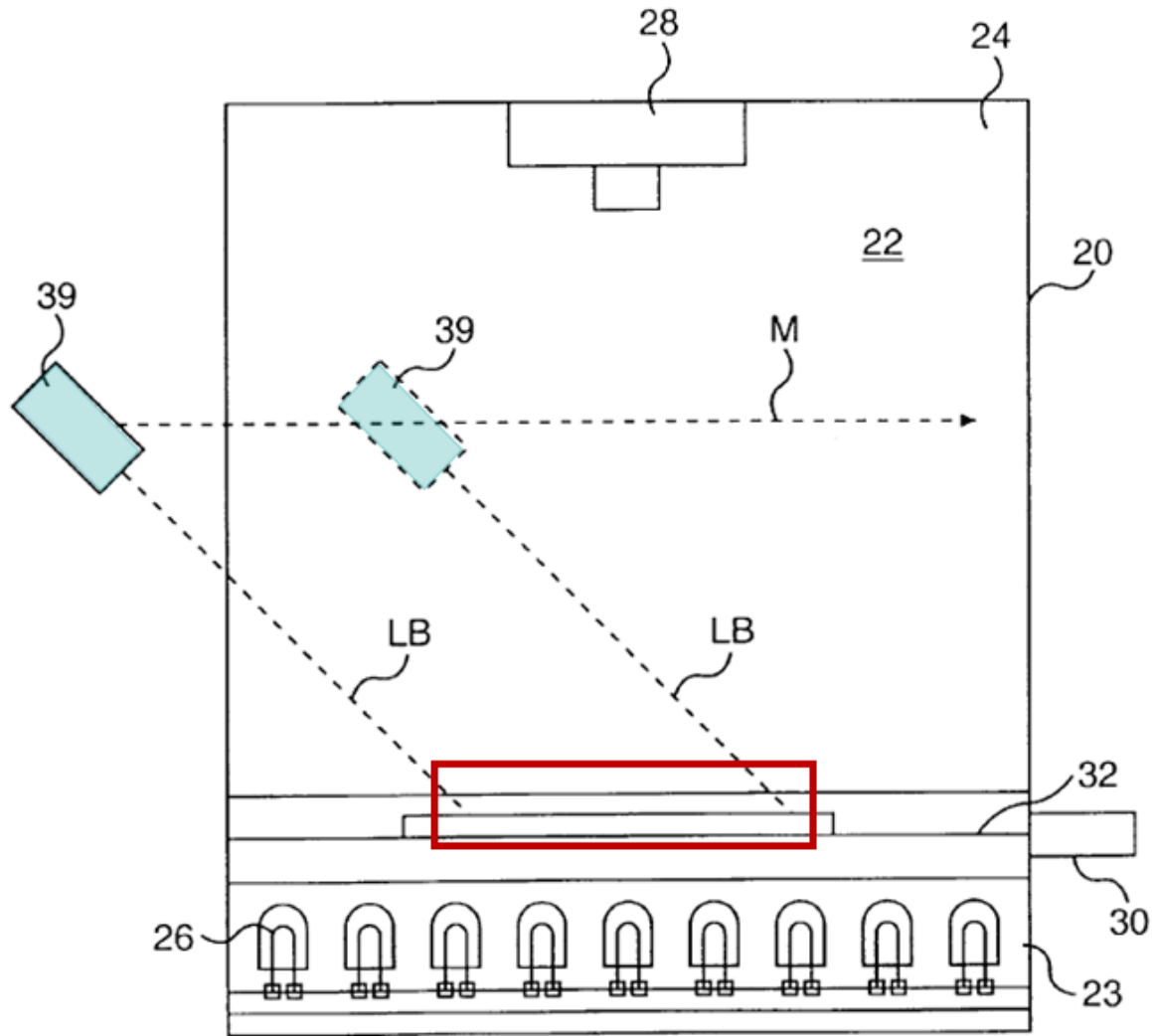
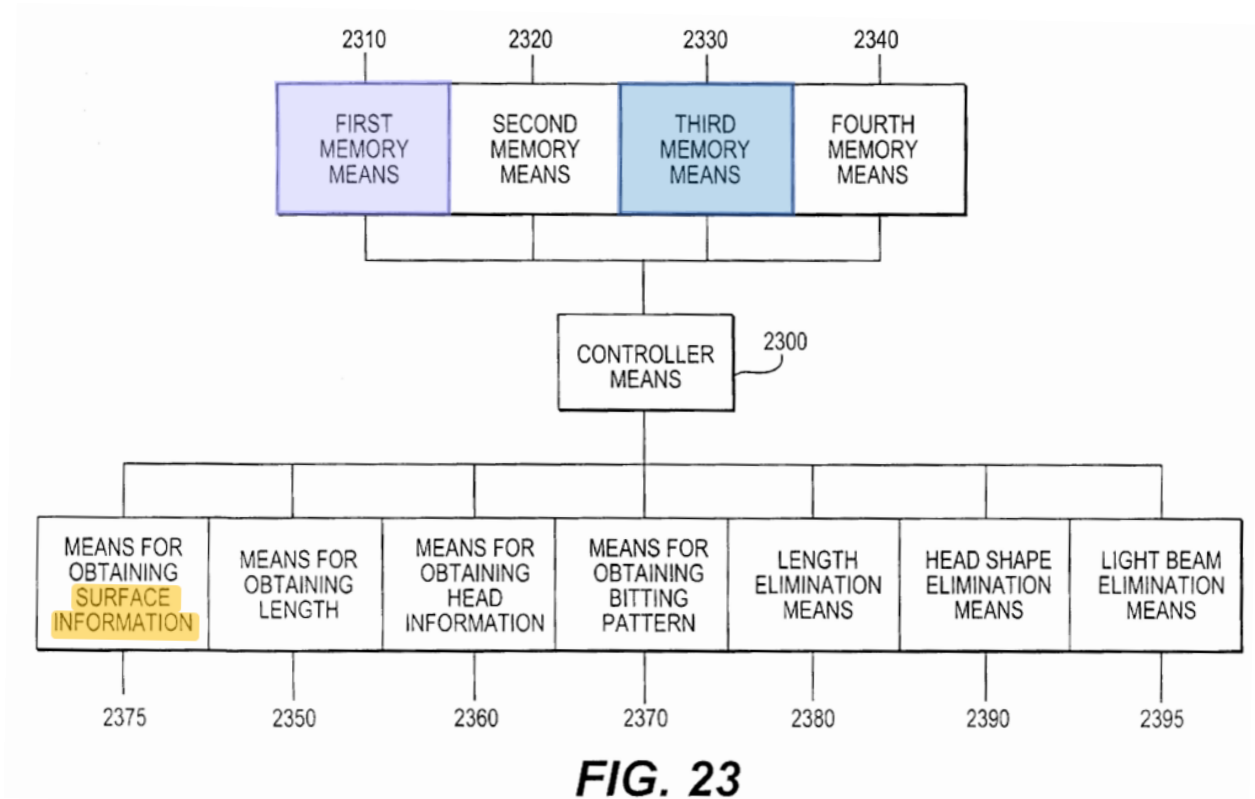


FIG. 8

Wills, Figure 8 (annotated).

37. According to *Wills*, one aspect of identifying a key blank, also called a “reference key” in *Wills*, is “analyzing the **surface information** of the master key, specifically the milling.” *Wills*, 11:36-39. To this end, *Wills*’s machine further includes a “computer subsystem,” as illustrated in Figure 23, that includes “means

for obtaining **surface information 2375**,” as shown. *Id.*, 31:67-32:2.



Wills, Figure 23 (annotated).

38. As *Wills* explains, “[l]ight beam **image** data represent[ing] the result of the light beam interfacing with the surface of the **master key** shown in FIG. 7A, specifically the surface shown in FIG. 7B” is “stored in the third memory means 2330” in Figure 23. *Wills*, 37:11-15. From the light beam **image** data, *Wills* explains, *Wills*’s machine “extracts **depth measurements**” for the **milling** of the **master key**. *Id.*, 37:16-19; see also *id.*, 37:20-39:1 (discussing pseudocode for extracting **depth measurements**).

39. *Wills*’s computer subsystem also stores “surface information of each of

the reference keys” in a “first memory means 2310,” as shown, which includes, for each reference key, “depth measurements across the width of the [reference] key.” *Wills*, 31:56-51; *see also id.*, 15:2-5 (“The memory means also stores information about the light beam LB interfacing with each of the reference keys . . .”).

40. To identify a reference key for the master key, a “light beam elimination means” of *Wills*’s computer subsystem compares the depth measurements for the master key with the depth measurements for the reference keys and, from the comparison, generates a “ranking ... from the most likely match” among the reference keys “to the least likely match.” *Wills*, 15:6-19; *see also id.*, Figures 31 (calculating a “surface score” for the reference keys) and 32 (factoring the “surface score” into the “overall score” and ranking keys by overall score).

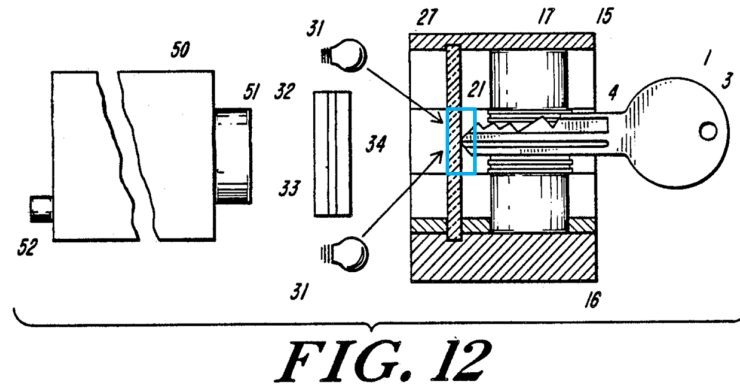
B. Cimino

41. U.S. Patent No. 4,899,391 (Ex. 1013) (“*Cimino*”) issued February 6, 1990. I understand *Cimino* constitutes prior art under at least pre-AIA 35 U.S.C. §§ 102(a), 102(b), and/or 102(e).

42. *Cimino*, like *Wills*, discloses a “system for identifying and matching key blanks when duplicating an original key.” *Cimino*, Abstract. *Cimino* discloses “an automatic key identification system comprised of a key holder subsystem 10, a lensing subsystem 30, a video subsystem 50, a digitizing subsystem 70, a computer subsystem 90, and an output subsystem 110.” *Id.*, 3:3-7. As in *Wills*, “key 1 to be

“**duplicate**” is inserted into the key holder 10” of *Cimino*’s machine. *Id.*, 3:7-8.

Figure 12 of *Cimino*, below, illustrates the imaging configuration.



Cimino, Fig. 12 (annotated)

43. *Cimino*’s “lensing subsystem 30 illuminates the front 2 of the key 1 forming a cross-sectional image 35 thereof.” *Id.*, 3:8-10. The “video subsystem 50 converts the image 35 into an electrical signal which the digitizing subsystem 70 converts into a digital image.” *Id.*, 3:10-12. *Cimino* explains that the “output of the lensing subsystem 30 is an end-on cross-section image 35 of the front 2 of the key 1.” *Id.*, 4:18-20. Fig. 14 of *Cimino*, below, illustrates an exemplary **end-on cross-section image 35** (e.g., **tip end** image) of a **master key**.



FIG. 14

Cimino, Fig. 14 (annotated)

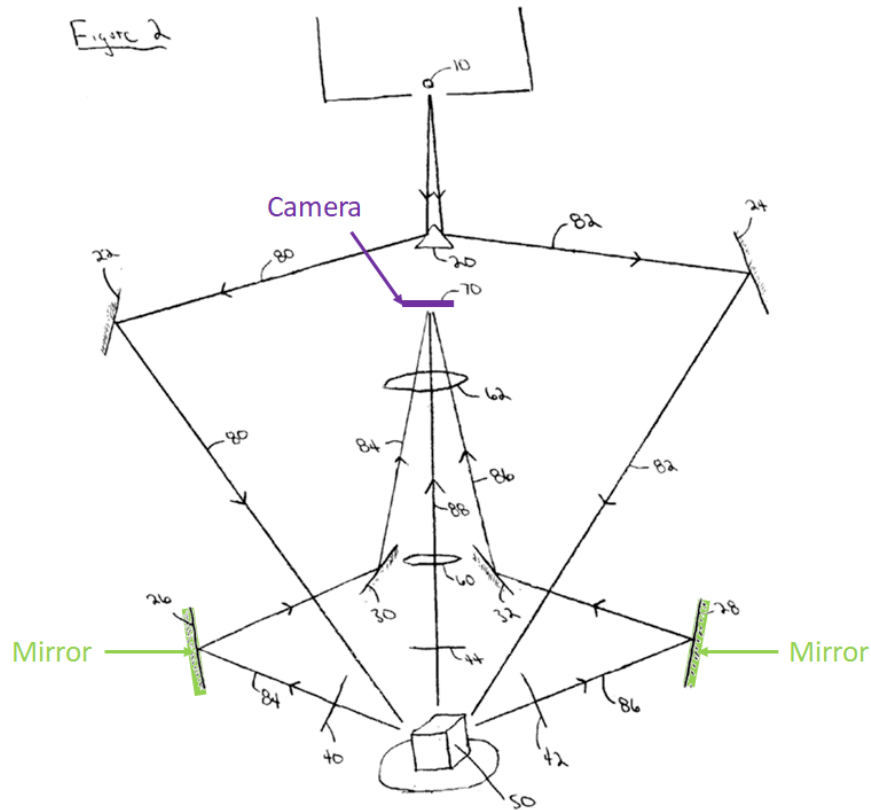
C. Shirley

44. U.S. Patent App. Pub. No. 2003/0072011 (Ex. 1014) (“*Shirley*”) published April 17, 2003. I understand *Shirley* constitutes prior art under at least pre-AIA 35 U.S.C. §§ 102(a), 102(b), and/or 102(e).

45. *Shirley* describes a “method and apparatus for combining multiple views of an object.” *Shirley*, Abstract. In particular, *Shirley* discloses obtaining an image of one surface of an object directly by the camera and further obtaining images of other sides of the object using one or more mirrors. *Id.*, ¶¶[0024]-[0025]. As illustrated in Figure 2, below, *Shirley* discloses an “image 88 formed by radiation reflected from a ... surface of the object 50 is focused on detector 70.” *Id.*, ¶[0025]. *Shirley* explains that “detector 70 is typically a CCD.” *Id.*, ¶ [0022].

46. *Shirley* further discloses an “image 84 formed by radiation reflected from the first surface of the object 50 is directed to a **second mirror 26**, which transmits the radiation to a third mirror 30 [that] directs the image 84 to the detector 70.” *Id.* ¶[0024]. *Shirley* similarly discloses an “image 86 formed by radiation reflected from the second surface of the object 50 is directed to a **fifth mirror 28**, which transmits the radiation to a sixth mirror 32 [that] directs image 86 to the detector 70.” *Id.*, ¶[0025]. Further, *Shirley* discloses “optical switches 40 and 42 are positioned to turn off either optical path, thus precluding the radiation from reaching the detector 70.” *Id.*, ¶[0021]. Likewise, “optical switch[] 44” may be used

to turn off optical path 88. *Id.*, ¶[0026].



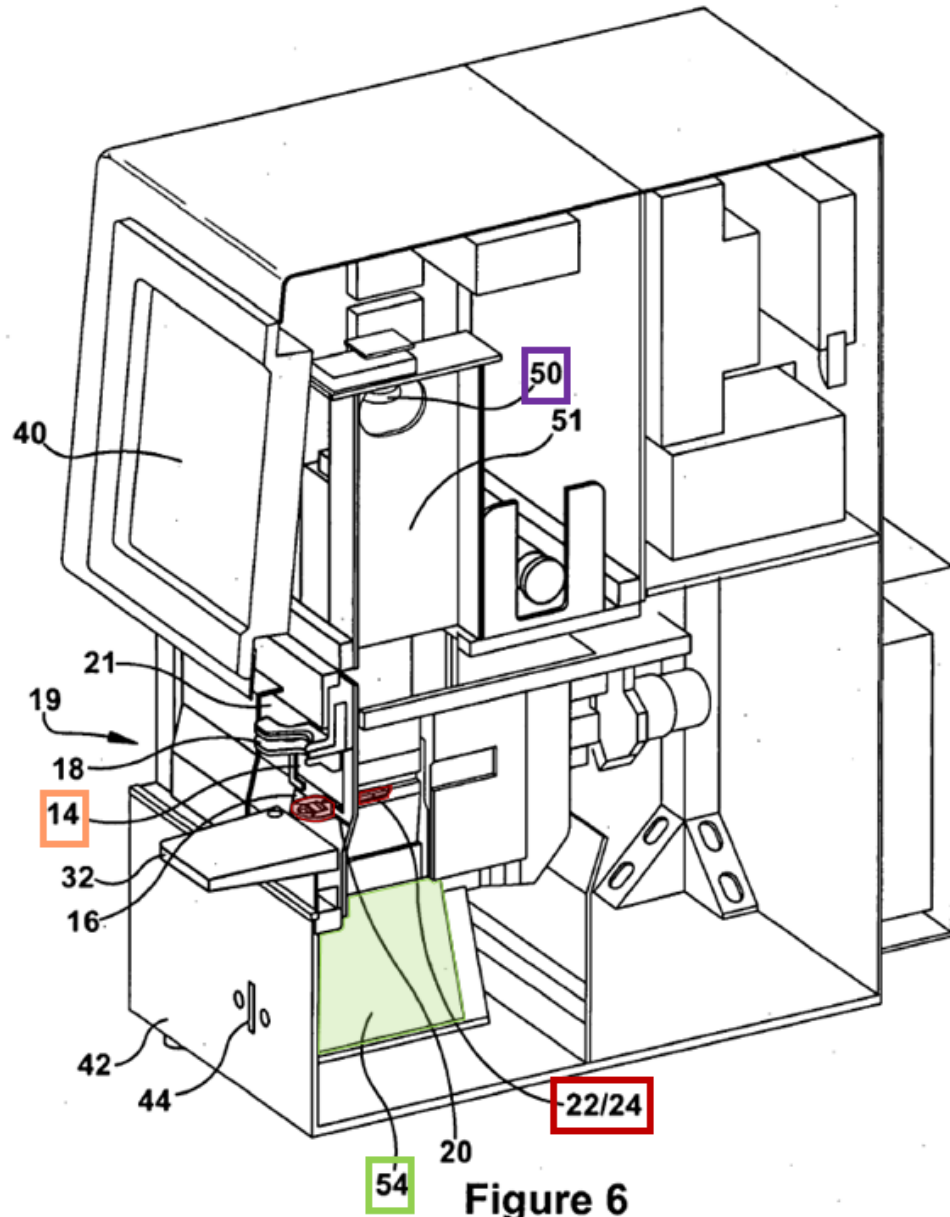
Shirley, Fig. 2 (annotated)

D. Bass

47. U.S. Patent App. Pub. No. 2007/0224008 (Ex. 1006) (“*Bass*”) published September 27, 2007. I understand *Bass* constitutes prior art under at least pre-AIA 35 U.S.C. §§ 102(a), 102(b), and/or 102(e).

48. *Bass*, like *Wills*, describes a machine for duplicating master keys. *Bass*, ¶[0009]. As in *Wills*, the master key of *Bass* is placed in the machine, and a camera, together with a reflecting plate, is used to capture an image of the master key, as shown in Figure 6. As in *Wills*, where the master key is placed into the machine on

a “supporting means,” *Wills*, 7:4-8, in *Bass*’s machine the **master key** is placed into the machine on a “base 16,” as shown, *Bass*, ¶¶[0047], [0050]. In addition, *Bass*’s machine employs a “**door clamp 14**,” as shown. *Bass*, ¶[0047].



Bass, Figure 6 (annotated).

E. Heide

49. U.S. Patent App. Pub. No. 2007/0233298 (Ex. 1007) (“*Heide*”)

published October 4, 2007. I understand *Heide* constitutes prior art under at least pre-AIA 35 U.S.C. §§ 102(a), 102(b), and/or 102(e).

50. *Heide* describes a “three-dimensional object” akin to the “three-dimensional surface image” captured by *Wills*’s machine. *Heide*, Abstract; *Wills*, 15:34-42. And just as *Wills* envisions “convert[ing]” its three-dimensional image “by ... rotating to a predetermined reference position and orientation,” *Wills*, 9:35-38, *Heide* teaches “rotat[ing]” its three-dimensional image “relative to one or more ... axes” to arrive at an “optimal spatial orientation.” *Heide*, ¶¶[0037]-[0038].

F. *Wills, Cimino, Shirley, Bass, and Heide* are Analogous Art to the ’385 Patent

51. I have been told that a reference is analogous art to the ’385 patent if the reference is from the same field of endeavor or is reasonably pertinent to one of the particular problems dealt with by the inventor. In my opinion, each of *Wills*, *Cimino*, *Shirley*, *Bass*, and *Heide* is analogous art to the ’385 patent. *Wills*, *Cimino*, and *Bass* are from the same field of endeavor as the ’385 patent, key duplication. See, e.g., *Wills*, 1:6-10; *Cimino*, Title; *Bass*, Title. Moreover, each of *Wills*, *Cimino*, *Bass*, *Heide*, and *Shirley* is reasonably pertinent to one of the particular problems dealt with by the inventor. *Wills*, *Cimino*, and *Bass* are pertinent to identifying an appropriate key blank to duplicate a master key. Compare ’385 patent, 1:18-22, with, e.g., *Wills*, 1:6-10; *Cimino*, 1:5-6, 1:37-58; *Bass*, ¶[0008]. *Heide* is pertinent to imaging an object and converting the image to a particular orientation.

Compare '385 patent, 7:17-29, *with, e.g., Heide*, Abstract, ¶[0004]. And *Shirley* is pertinent to imaging an object from different angles or sides. *Compare* '385 patent, 4:10-20, *with, e.g., Shirley*, Abstract, ¶¶[0024]-[0027].

VII. THE '385 PATENT

52. The '385 patent describes a “key identification system” that “capture[s] an image of a master key” and uses “logic to analyze the image” to identify a key blank for use in duplicating the key. '385 patent, 2:28-30. A master key is illustrated in Figure 1. As shown, the “**master key** 10” includes a “**blade** 18” in which a “**groove** 11” is formed. '385 patent, 3:54-56. A “**tip** 14” of the **master key** is shown as well. *Id.*, 5:10-13.

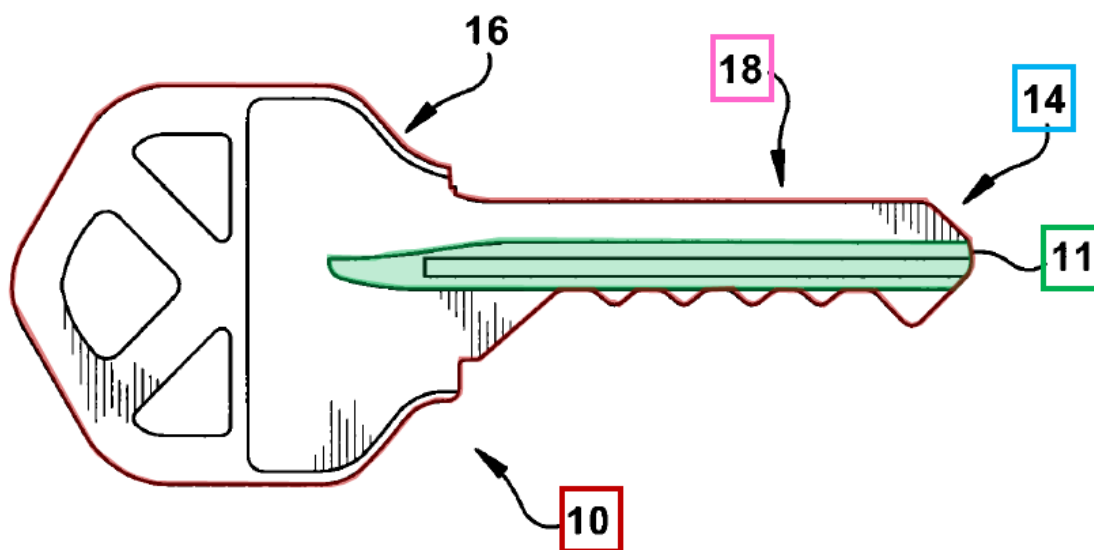


FIG. 1

'385 patent, Figure 1 (annotated).

53. An embodiment of the key identification system of the '385 patent is illustrated in Figure 2a. As shown, “an imaging system,” shown to include a camera, is “configured to capture an image of the tip of [the] master key.” *Id.*, 10:49-51.

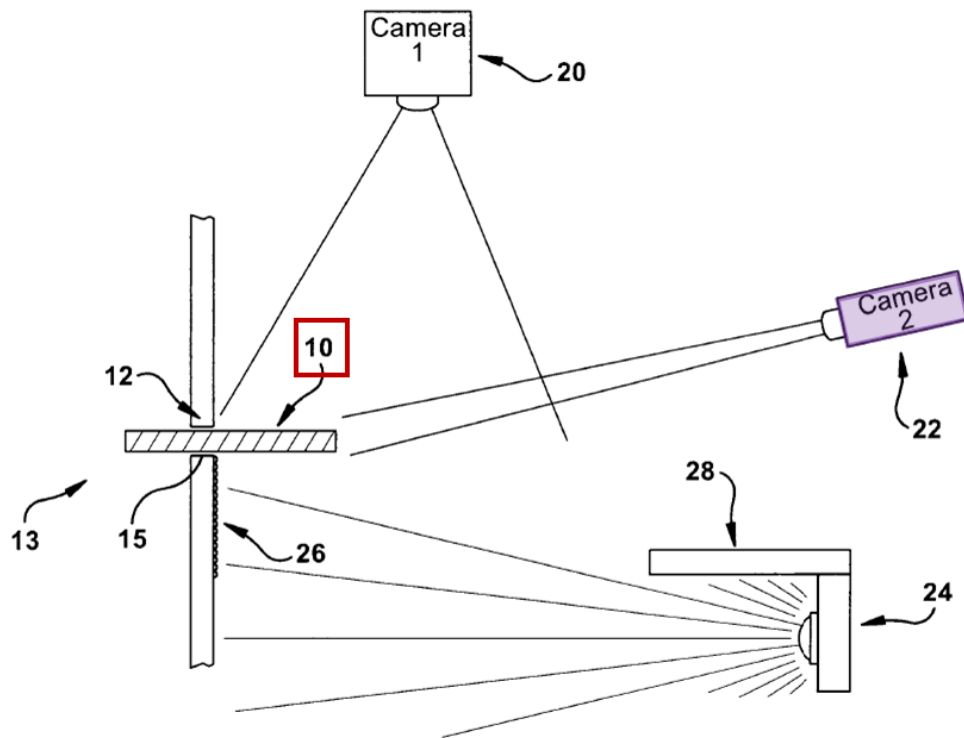


FIG. 2a

'385 patent, Figure 2a (annotated).

54. The image captured by the camera “includes a contour,” and the key identification system uses a “logic” to “analyze [the] captured image to determine characteristics of [the] contour[,] ... based on image data from at least said two or more views of said master key wherein at least one said view is substantially a tip end view.” *Id.*, 10:52-63. The logic also “compare[s] [the] characteristics with characteristics of known key blanks to determine the likelihood of a match between [the] master key and a known key blank.” *Id.*, 10:54-56.

VIII. CLAIM CONSTRUCTION

55. I have applied the above-mentioned legal standards of claim

construction here. As noted above, I understand that there is a special category of claim terms, known as “means-plus-function” terms, that recite a structural component solely in terms of the function it performs. I have been told that construing means-plus-function terms involves two steps: (1) identifying the claimed function, and (2) determining what structure, if any, disclosed in the specification corresponds to that claimed function.

56. Claim 1 of the '385 patent recites “a logic configured to analyze said captured image to determine characteristics of said contour and compare said characteristics with characteristics of known key blanks to determine the likelihood of a match between said master key and a known key blank ... wherein said logic calculates the geometry of the contour based on data from at least said two or more views of said master key.” '385 patent, 10:52-56, 10:62-64. In my opinion, to the extent the Board determines the claimed “logic” should be construed as a means-plus-function term, the function of the “logic” in the '385 patent is “to analyze said captured image to determine characteristics of said contour and compare said characteristics with characteristics of known key blanks to determine the likelihood of a match between said master key and a known key blank ... wherein said logic calculates the geometry of the contour based on data from at least said two or more views of said master key,” as recited in claim 1. '385 patent at 10:52-56, 10:62-64. Likewise, claims 10, 11, 13, 14, 22, 23, 24, and 26 recite addition functions of the

claimed “logic.” *Id.*, 11:19-26, 11:31-38, 12:7-30, 12:45-49. The corresponding structure is described in the ’385 patent at 4:22-38, which states:

[T]he term “logic” includes but is not limited to a software, a firmware, an executable program, a hardware or hard-wired circuit, or combinations thereof. For example, based on a desired application or needs, a logic may include a software controlled microprocessor, discrete logic like an application specific integrated circuit (ASIC), an analog circuit, a digital circuit, a programmed logic device, a memory device containing instructions, or the like. Logic may include one or more gates, combinations of gates, or other circuit components. Logic may also be fully embodied as software. Where multiple logical logics are described, it may be possible to incorporate the multiple logical logics into one physical logic. Similarly, where a single logical logic is described, it may be possible to distribute that single logical logic between multiple physical logics.

57. Based on these teachings of the ’385 patent, it is my opinion that a POSA would have understood that the disclosed structure for performing this function encompasses, among other things, software programs stored on a hard disk.

IX. THE CHALLENGED CLAIMS ARE UNPATENTABLE

58. As described below, it is my opinion that *Wills* in combination with *Cimino* and *Shirley* would have rendered obvious claims 1-5, 7, 10, 13-16, and 20-26; that *Wills* in combination with *Cimino*, *Shirley*, and *Bass* would have rendered obvious claims 6, 17, and 18; and that *Wills* in combination with *Cimino*, *Shirley*,

and *Heide* would have rendered obvious claims 9 and 11.

A. Ground 1: *Wills* in view of *Cimino* and *Shirley* Would Have Rendered Obvious Claims 1-5, 7, 10, 13-16, and 20-26

1. Claim 1

59. *Wills* in view of *Cimino* and *Shirley* renders obvious claim 1.

a. 1[p] A key identification system comprising:

60. *Wills* describes “[a] key identification system.” *Wills* describes a “key regenerating machine in which [a] master key is optically analyzed [and] the appropriate key blank determined.” *Wills*, 1:7-11.

b. 1[a] an imaging system including a camera configured to capture an image of the tip of a master key, wherein said image includes a contour; and

61. *Wills* discloses “an imaging system including a camera configured to capture an image of the tip of a master key, wherein said image includes a contour.” *Wills* describes a machine “including a camera configured to capture an image of the tip of a master key.” *see also infra* claim 3 (*Wills*’s machine includes “a reflecting device”); claim 4 (*Wills*’s machine includes “a light”). *Wills*’s image includes surface information, including a depth, of a milling in the master key.

62. *Wills* discloses a “master key” that includes a “tip.” As *Wills* explains with reference to Figure 1A, “the keys discussed [in *Wills*] each have a head H [and] a length LH that is the combination of the head H and a blade B.” *Wills*, 5:11-13. “More specifically,” *Wills* explains, “the length LH of the key extends from the tip

TP of the blade B to the top of the head H.” *Id.*, 5:13-15.

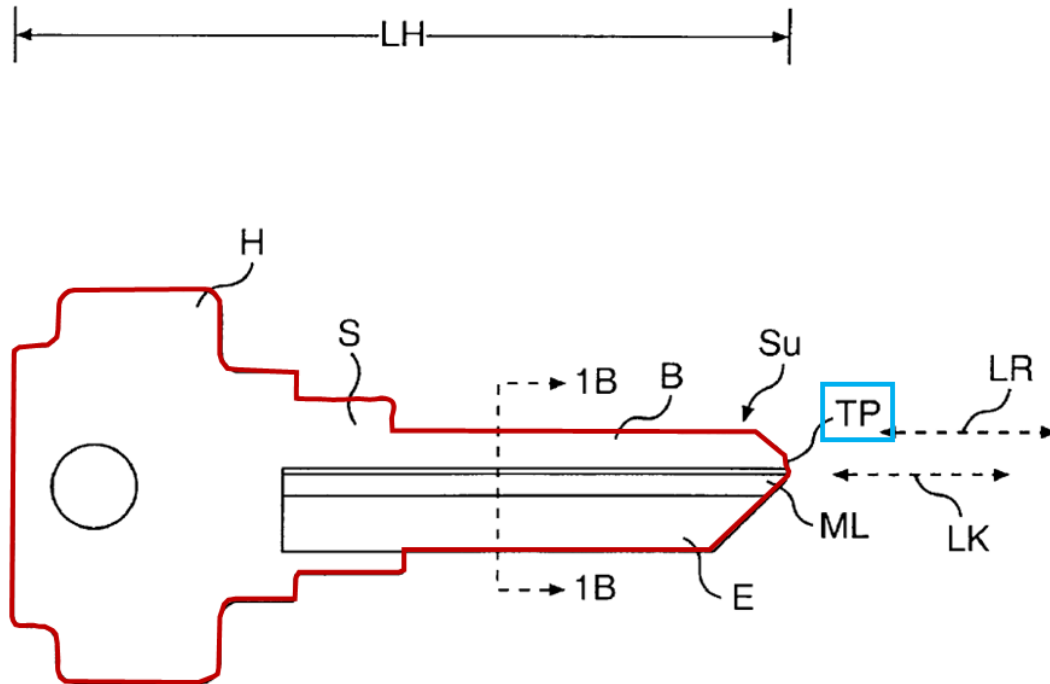


FIG. 1A

Wills, Figure 1A (annotated).

63. *Wills* discloses a machine “including a camera configured to capture an image of the tip of a master key.” An example embodiment of *Wills*’s machine, including a “camera 28,” is shown in Figure 8. *Id.*, 7:39-41. *Wills*’s camera is “configured to capture an image of the tip of a master key” because *Wills*’s camera is used to capture “an entire three-dimensional surface image of the [master] key” by capturing two-dimensional slices “along the length of the key,” which includes the tip. *Id.*, 15:34-42.

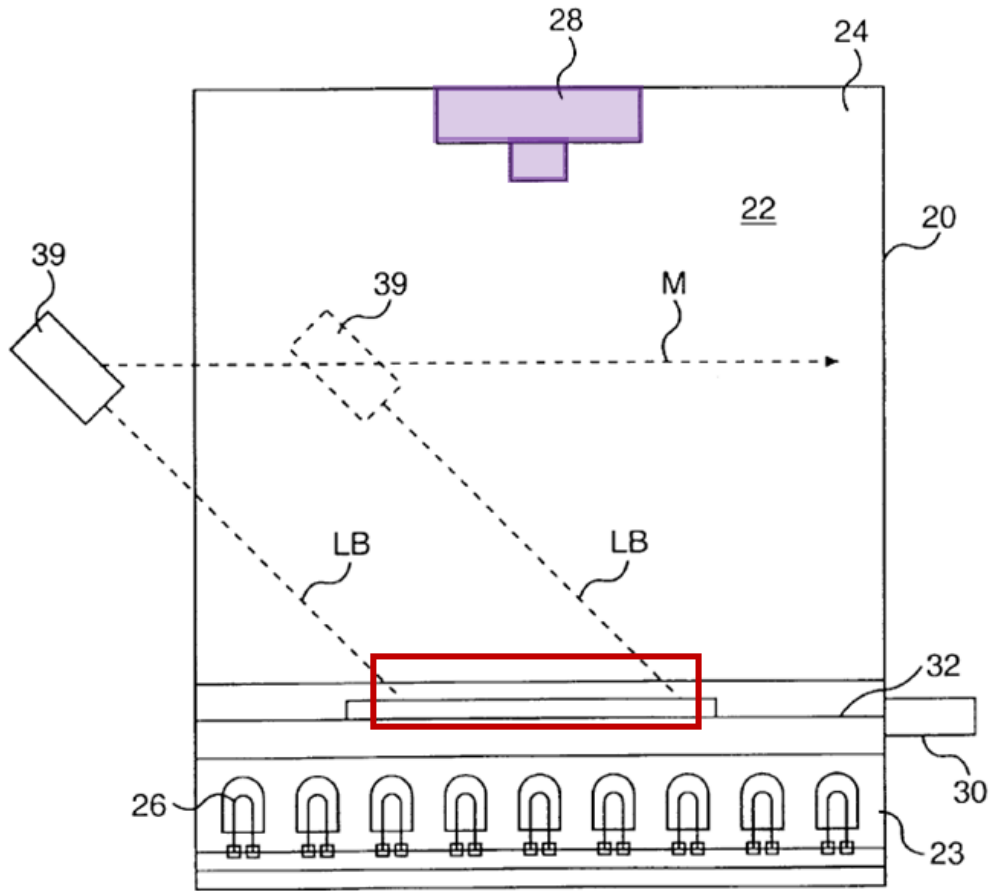


FIG. 8

Wills, Figure 8 (annotated).

64. In particular, as *Wills* explains with reference to Figure 8, “[a]s light beam LB is swept along the length of the [master] key, illustrated by the second laser line generator 39 in phantom lines, a series of two-dimensional slices is generated,” and these “slices are stacked to form the entire three-dimensional representation of the key.” *Id.*, 15:40-50. Because *Wills* describes capturing the two-dimensional slices “along the length of the key,” which includes the tip, *id.*, 5:11-15, a POSA

would have understood from *Wills* that either (i) a two-dimensional slice captured at the tip of the master key or (ii) the resulting three-dimensional representation, which would include the tip of the master key, is “an image of the tip of [the] master key.” In this manner, *Wills*’s camera is “a camera configured to capture an image of the tip of a master key.”

65. *Wills* also discloses that the “image includes a contour” because the captured image in *Wills*—whether the two-dimensional slice captured at the tip of the master key or the resulting three-dimensional representation, which would include the tip of the master key—includes surface information, including a depth, of a milling in the master key.

66. As Figure 7A shows, *Wills*’s master key includes the blade, labeled “BD,” in which is formed the milling, labeled “ML,” which *Wills* describes as “a longitudinally-extending groove ... in the blade.” *Id.*, 5:22-24, 5:56-59.

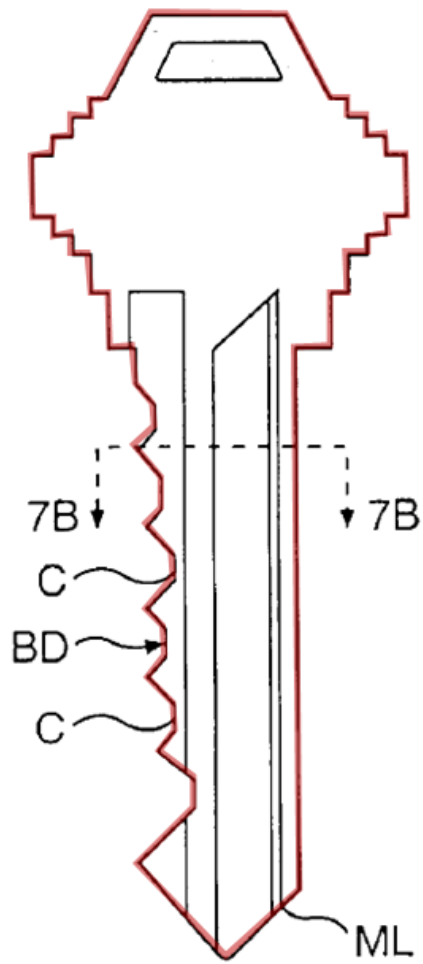


FIG. 7A

Wills, Figure 7A (annotated).

67. The milling, or groove, of the **master key** in Figure 7A has particular “**surface information**,” such as a “**depth**,” as shown in Figure 7B, which is a cross-section of Figure 7A along the line 7B–7B. *Wills*, 5:61-65, 11:59-63.



FIG. 7B

Wills, Figure 7B (annotated).

68. In my opinion, a POSA would have understood the **surface information**, such as the **depth** of the milling, or groove, of *Wills*’s **master key** to be a “a **contour**” of the **master key**. As Figure 3 of the ’385 patent shows, the **contour** of the **master key** in the ’385 patent, like the **surface information** of the **master key** in *Wills*, is a physical geometry of a groove in the **master key**. ’385 patent, 5:37-38; *see also id.*, Figure 6 (showing “**contour** data related to **contours** of the groove” in Figure 3), Figure 7 (showing calculated “groove **contours**”), 4:64-66 (describing

“[c]haracteristics of the grooves,” including “the size, location, angle, and other geometric parameters of a given groove”), 5:41-43 (describing “groove geometry”).

69. The **image** captured in *Wills* includes the **surface information**, such as the **depth**, of the milling in the **master key**. The **two-dimensional slice** captured by the **camera**, shown in Figure 7D, “is the result of the light beam interfacing with the surface of the **master key** shown in FIG. 7A, specifically the surface shown in FIG. 7B,” which, as shown above, includes the **surface information**, such as the **depth**, of the milling. *Wills*, 11:59-63. As Figure 7D shows, the **two-dimensional slice** captured by the **camera** likewise includes the **surface information** of the **master key**, including the “**depth** of [the] milling.” *Id.*, 13:1-3. While Figure 7D, which corresponds to “the surface shown in FIG. 7B,” illustrates a **two-dimensional slice** taken along the line 7B–7B in Figure A, *id.*, 3:11-12, a POSA would have understood from *Wills* that, among the two-dimensional slices taken “along the length of the **key**” would be the **two-dimensional slice** captured at the **tip** of the **master key**, and this **two-dimensional slice** captured at the **tip** would, like the **two-dimensional slice** taken along the line 7B–7B, include the **surface information** of the **master key**, including the “**depth** of [the] milling.” Moreover, a POSA would have recognized that the **three-dimensional representation** in *Wills* would likewise include the **surface information**, such as the **depth**, of the milling, as the **three-dimensional representation** is simply formed by “stack[ing]” the two-dimensional slices—each

including surface information for the slice—captured “along the length of the key.”

Id., 15:40-47.

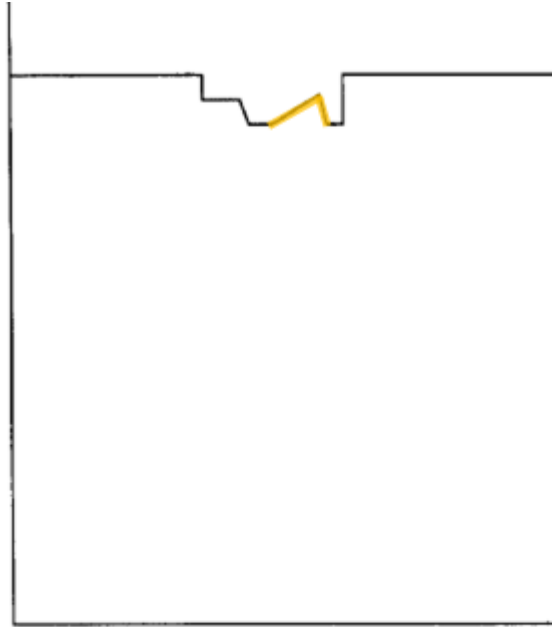


FIG. 7D

Wills, Figure 7D (cropped and annotated).

70. Thus, because *Wills*’s machine includes a camera configured to capture an image of the tip of a master key, and *Wills*’s image includes surface information, including a depth, of the milling in the master key, *Wills* discloses “an imaging system including a camera configured to capture an image of the tip of a master key, wherein said image includes a contour.”

- c. 1[b] a logic configured to analyze said captured **image** to determine **characteristics** of said **contour** and compare said **characteristics** with **characteristics of known key blanks** to determine the likelihood of a match between said **master key** and a known key blank; and

71. *Wills* discloses “a logic configured to analyze said captured **image** to determine **characteristics** of said **contour**” because *Wills* describes a computer subsystem configured to analyze the captured **image** to determine **depth measurements** of the milling based on the **surface information**, including the **depth**.

72. *Wills* describes “analyzing the **surface information** of the master key, specifically the milling,” to identify a reference key for the master key. *Wills*, 11:36-39. To this end, *Wills*’s machine further includes a “computer subsystem,” as illustrated in Figure 23, that includes “means for obtaining **surface information** 2375,” as shown. *Id.*, 31:44-47, 32:1-2.

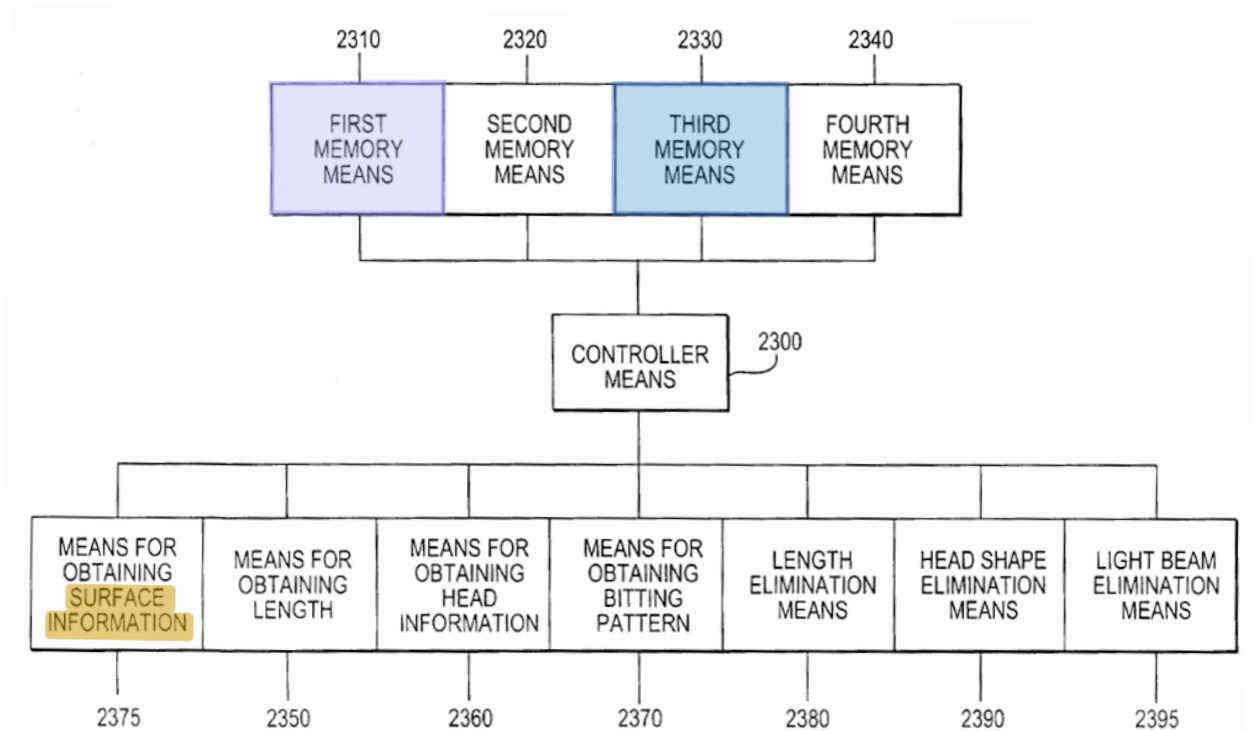


FIG. 23

Wills, Figure 23 (annotated).

73. As explained for claim 1[a], *Wills*’s *image*—whether the *two-dimensional slice* or the *three-dimensional representation* formed by stacking the two-dimensional slices—includes *surface information*, including a *depth*, of the milling in the *master key*. *Wills* explains that data corresponding to this *image* is “stored in the third memory means 2330” in Figure 23. *Wills*, 37:11-15. From the *image* data, *Wills* explains, the means for obtaining *surface information* “extracts *depth measurements*” for the milling in the *master key*. *Wills*, 37:16-19; *see also id.*, 37:20-39:1 (discussing pseudocode for extracting *depth measurements*). A POSA would have understood the *depth measurements* extracted by *Wills*’s computer

subsystem to be “characteristics of said contour” because the depth measurements are measurements of the milling and reflect the surface information, including the depth, captured in the image.

74. *Wills* also discloses “a logic configured to ... compare said characteristics with characteristics of known key blanks to determine the likelihood of a match between said master key and a known key blank” because *Wills*’s computer subsystem is also configured to compare the depth measurements of the milling with depth measurements of reference keys to determine a likelihood of a match between the master key and each reference key.

75. As *Wills* explains, its computer subsystem also stores “surface information of each of the reference keys” in a “first memory means 2310,” as shown in Figure 23. *Wills*, 31:56-61. This “surface information of each of the reference keys” includes, for each reference key, “depth measurements across the width of the [reference] key.” *Id.*, 32:57-61; *see also id.*, 15:2-5 (“The memory means also stores information about the light beam LB interfacing with each of the reference keys. . .”).

76. To identify a reference key for the master key, *Wills* explains, a “light beam elimination means 2395” of *Wills*’s computer subsystem compares the depth measurements for the master key with the depth measurements for the reference keys and, from the comparison, generates a “ranking ... from the most likely match” to

the **master key** among the reference keys “to the least likely match.” *Id.*, 15:6-19; *see also id.*, Figures 31 (calculating a “surface score” for the reference keys) and 32 (factoring the “surface score” into the “overall score” and ranking keys by overall score).

77. In my opinion, a POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely “analyz[ing] said captured **image** to determine **characteristics** of said **contour** and compar[ing] said **characteristics** with **characteristics of known key blanks** to determine the likelihood of a match between said **master key** and a known key blank.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

- d. 1[c] one or more **mirrors** positioned to allow said camera to capture two or more views of the **master key** wherein said **characteristics** of said **contour** are determined based on **image data** from at least said two or more views of said **master key** wherein at least one said view is substantially a tip end view, and wherein said logic calculates the geometry of the **contour** based on data from at least said two or more views of said **master key**.

78. *Wills* in view of *Cimino* and *Shirley* teaches this element. *Wills* discloses “one or more **mirrors** positioned to allow said camera to capture two or more views of the **master key**” because *Wills*’s machine employs a “**mirror** 29,” shown in Figure 9, that “reflects the image [of the **master key**] to the **camera** 28” to be captured. *Wills*, 7:47-48.

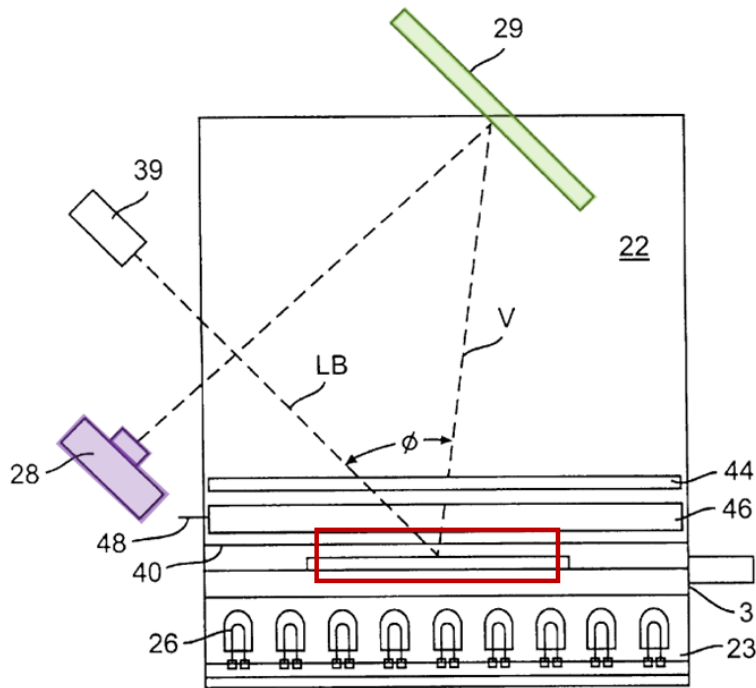


FIG. 9

Wills, Figure 9 (annotated)

79. *Wills* discloses “capturing two or more views of the master key” using the one or more mirrors in two ways: (i) *Wills* discloses capturing images of a plurality of two-dimensional slices captured of the **master key**; and (ii) *Wills* envisions capturing images of both sides of the **master key**.

80. Regarding (i), as explained for claim 1[a], *Wills* describes capturing **images** in the form of **two-dimensional slices** “along the length of the **key**.” *Wills*, 15:34-42. As *Wills* explains with reference to Figure 8, “[a]s the light beam LB is swept along the length of the **[master] key**, illustrated by the second laser line generator 39 in phantom lines, a series of two-dimensional slices is generated,” and

these “slices are stacked to form the entire three-dimensional representation of the key.” *Id.*, 15:40-50.

81. In my opinion, although, the series of two-dimensional slices of *Wills* is described in terms of the embodiment of Figure 8, which does not include a mirror, such two-dimensional slices would also be obtained using a **mirror** as disclosed in the Figure 9 embodiment of *Wills* by moving laser line generator 39 along the length of the **master key**. *Wills*, 12:51-52 (“It is also contemplated that the laser line generator 39 could be moved along an axis.”). I note that *Wills* itself explains that “**camera** 28 can be mounted vertically over the drawer 30 if the focal length is appropriate for the dimensions of the machine 10” or an alternative embodiment (e.g., that of Figure 9) “uses a **mirror** 29 to accommodate the focal length for the CCD **camera** 28 ... to minimize the size of machine 10.” *Wills*, 7:44-48. In my opinion, therefore, *Wills* discloses obtaining two or more images (e.g., two-dimensional slices along a length of the key) using a **mirror** to reflect the image of the master key to the **camera** 28 in the same manner as described for the Figure 8 embodiment. These two-dimensional images are representative of the views of the key as seen by *Wills*’s **camera** 28.

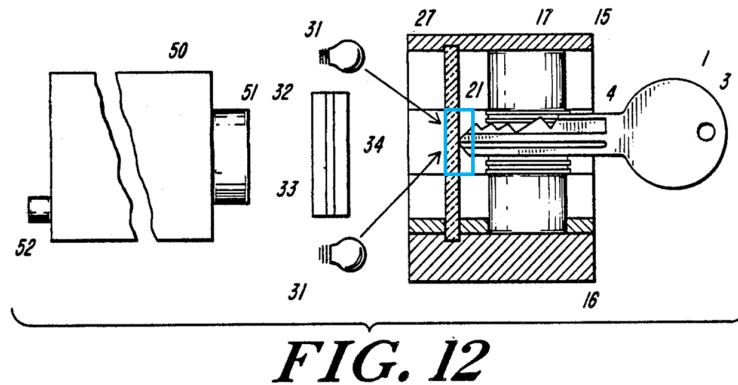
82. Regarding (ii), *Wills* envisions capturing images of both sides of the **master key**. In particular, *Wills* envisions that, in some embodiments, the machine “prompts the operator to remove the **master key** from the [machine] and flip it over

so that the milling on the reverse side can be scanned and used in the identification process.” *Wills*, 15:26-30. In my opinion, to scan the milling on the reverse side, *Wills*’s camera would also capture a plurality of two-dimensional slices of the reverse side using “mirror 29,” in the same manner as described above. Because *Wills* discloses obtaining images of both sides of the key using “mirror 29,” in my opinion, *Wills* discloses “one or more mirrors positioned to allow said camera to capture two or more views of the master key.” The images of both sides of *Wills*’s key represent two or more views of the master key as seen by the camera.

83. *Wills* also discloses that “at least one said view is substantially a tip end view.” As explained above, *Wills* describes capturing images in the form of two-dimensional slices “along the length of the key.” In my opinion, a POSA would understand that an image representing a two-dimensional slice, as taught by *Wills*, taken at the tip end of the master key, would represent substantially a tip end view of the master key.

84. To the extent *Wills* does not explicitly teach or suggest substantially a tip end view, *Cimino* teaches this feature. Like *Wills*, *Cimino* discloses a “system for identifying and matching key blanks when duplicating an original key.” *Cimino*, Abstract. *Cimino* discloses “an automatic key identification system comprised of a key holder subsystem 10, a lensing sub system 30, a video subsystem 50, a digitizing subsystem 70, a computer subsystem 90, and an output subsystem 110.” *Id.*, 3:3-7.

Further, *Cimino* discloses that “lensing subsystem 30 illuminates the front 2 of the key 1 forming a cross-sectional image 35 thereof” and “video subsystem 50 converts the image 35 into an electrical signal which the digitizing subsystem 70 converts into a digital image.” *Id.*, 3:8-12. Fig. 12 of *Cimino*, below, illustrates the imaging configuration.



Cimino, Fig. 12 (annotated).

85. *Cimino* explains that the “output of the lensing subsystem 30 is an end-on cross-section image 35 of the front 2 of the key 1.” *Id.*, 4:18-20. Figure 14 of *Cimino*, below, illustrates an exemplary end-on cross-section image 35 (e.g., [tip end image](#)) of a [master key](#).



FIG. 14

Cimino, Fig. 14 (annotated)

86. In my opinion, from *Cimino*, a POSA would have been motivated and found it obvious to modify *Wills*'s machine to similarly obtain a substantially **tip end** view of the **master key** as taught by *Cimino*. A POSA would have understood that the tip end view "provides the distinctive features," which may be used to distinguish between different types of key blanks. *Cimino*, 2:55-56. In particular, a POSA would have understood that a two-dimensional slice in *Wills* may not accurately represent the milled groove, for example, when the groove includes debris, is damaged, or when the **master key** is bent at the location of that two-dimensional slice. For example, a two-dimensional slice, obtained by *Wills* at a location where the groove was filled with debris, would represent a depth of groove that would be smaller than the actual depth of the groove. In my opinion, a POSA would have recognized that in such cases, a **tip end** view as taught by *Cimino* would provide an image of portions of the groove not containing any debris. Thus, the **tip end** view would depict a more representative geometry of the **contour** of the milled grooves on both sides of the **master key**.

87. A POSA would have also recognized that the **tip end** view of *Cimino* would simultaneously provide both the top and bottom views of the milling on the **master key**. This would have eliminated the need to manually flip the **master key** to obtain images of both sides, helping to automate *Wills*'s machine, thereby further reducing the time required to identify a key blank. A POSA would, therefore, have

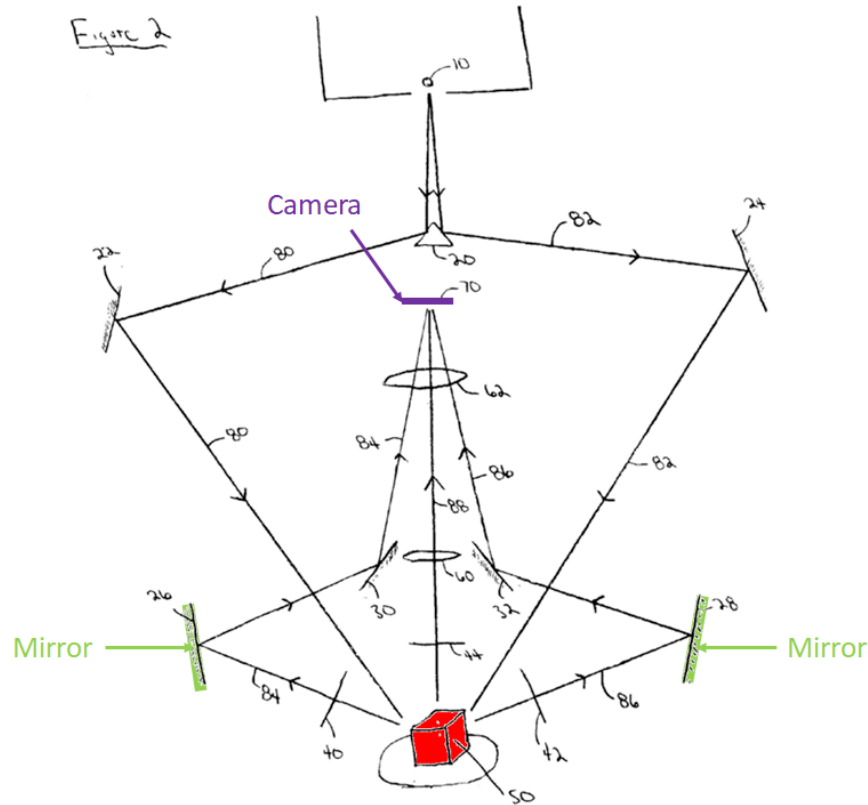
been motivated to modify *Wills*'s machine to additionally obtain a **tip end** view of the **master key** as taught by *Cimino* to realize the advantages of improved automation and accurate **contour** geometry determination.

88. Further, a POSA would have recognized that it would be possible to use the **tip end** view of the **master key** as taught by *Cimino* to confirm whether a key blank identified using the two-dimensional images of *Wills* is the correct key blank. For example, *Cimino* discloses comparing the **tip end** view of the **master key** with similar tip end views of saved images of key blanks. *Cimino*, 5:49-57. Further, *Cimino* discloses that a “matched saved image is identified.” *Id.*, 5:59. In my opinion, a POSA would have been motivated to compare the **tip end** view of the **master key** as taught by *Cimino* with a saved image of a key blank identified using two-dimensional images of *Wills*, to determine whether there is a match, which would confirm that the key blank has been correctly identified. A POSA would, therefore, have been motivated to modify *Wills*'s machine to obtain a **tip end** view of the **master key** as taught by *Cimino* to realize the additional advantage of being able to confirm that the correct key blank has been identified.

89. A POSA would have found such a modification obvious because it would have involved nothing more than the use of a known technique—obtaining a **tip end** view of the **master key** taught by *Cimino*—to improve a similar device—*Wills*'s key regenerating machine—in the same way, namely, by providing an

additional image for use in determining a key blank corresponding to a **master key**.

90. *Wills* and *Shirley* teach obtaining the tip end view using a mirror. *Shirley* discloses an “image 88 formed by radiation reflected from a ... surface of the **object 50** is focused on **detector 70**.” *Shirley*, ¶[0025]; *id.*, ¶[0022] (“The detector 70 is typically a CCD”). A POSA would have understood that *Shirley*’s CCD (e.g., charge coupled device) is a camera. *Shirley* also discloses an “image 84 formed by radiation reflected from the first surface of the **object 50** is directed to a **second mirror 26**, which transmits the radiation to a third mirror 30 [that] directs the image 84 to the **detector 70**.” *Id.* ¶[0024]. *Shirley* similarly discloses an “image 86 formed by radiation reflected from a second surface of the **object 50** is directed to a **fifth mirror 28**, which transmits the radiation to a sixth mirror 32 [that] directs image 86 to the **detector 70**.” *Id.*, ¶[0025]. Thus, as illustrated in Figure 2, below, *Shirley*’s **detector 70** obtains images of different sides of **object 50** using **mirrors 26 and 28**.



Shirley, Fig. 2 (annotated)

91. In my opinion, a POSA would have understood from *Shirley* that if object 50 were a key with the tip end pointing towards mirror 26, detector 70 (e.g., camera) of *Shirley* would have obtained an image of a tip end view of object 50 (e.g., key) using a mirror (e.g., mirror 26). From *Shirley*, a POSA would have been motivated and found it obvious to further modify *Will's* machine as modified by *Cimino* to include one or more mirrors as taught by *Shirley* to obtain images of the tip end of a master key without having to relocate *Wills's* camera, without having to use a different camera (e.g., a camera pointing at the tip end as taught by *Cimino*), and/or without having to move the position of the master key relative to the camera

to obtain the different images. A POSA would have recognized that eliminating the need for relocating the camera or including one or more additional cameras would have simplified the construction of *Wills*'s machine, and potentially also helped to reduce the size of *Wills*'s machine. *Wills*, 7:45-50. Accordingly, a POSA would have been motivated to implement the one or more mirrors taught by *Shirley* in *Wills*'s machine as modified by *Cimino* to capture an image of the tip end view of the master key using one or more mirrors.

92. A POSA would have found such a modification obvious because it would have involved nothing more than the use of a known technique—*Shirley*'s mirrors—to improve a similar device—*Wills*'s key regenerating machine modified by *Cimino*—in the same way, namely, by allowing *Wills*'s camera to capture images representing views of different sides of a master key using the mirrors taught by *Shirley*. Such a modification would have been within the skill of the POSA and yielded nothing more than predictable results. In my opinion, a POSA thus would have had a reasonable expectation of success in making the modification.

93. Given the similarities between *Wills*'s and *Cimino*'s machines, in my opinion, modifying *Wills*'s machine to additionally obtain a tip end image as taught by *Cimino* would have been within the skill of the POSA and yielded nothing more than predictable results. Likewise, given that use of mirrors was well-known in the art, in my opinion, adding a mirror taught by *Shirley* in *Wills*'s machine as modified

by *Cimino* to obtain the tip end image would also have been within the skill of the POSA and yielded nothing more than predictable results. A POSA thus would have had a reasonable expectation of success in making these modifications.

94. *Wills* also discloses that “said **characteristics** of said **contour** are determined based on image data from at least said two or more views of said **master key**” in two ways: (i) *Wills*’s **depth measurements** of the **surface information** are determined based on at least two or more of the two-dimensional slices captured of the **master key**; and (ii) *Wills* envisions extracting **depth measurements** of the **surface information** based on images captured of both sides of the **master key**.

95. Regarding (i), as explained for claim 1[b], *Wills* describes using the “means for obtaining **surface information**” of its computer subsystem to “extract[] **depth measurements**” for the **master key** from the **image** data. *Wills*, 31:44-47, 32:1-2, 37:11-19; *see also id.*, 37:20-39:1 (discussing pseudocode for extracting **depth measurements**). Each **two-dimensional slice** is a “view[] of said **master key**” because each is taken “along the length of the **key**,” as illustrated in Figure 8. *Wills*, 15:34-42; *see also id.*, 15:40-50 (“As [a] light beam LB is swept along the length of the **[master] key**, illustrated by the second laser line generator 39 in phantom lines, a series of two-dimensional slices is generated.”). *Wills* describes determining the **depth measurements** for “each lengthwise slice of the **key**”—that is, each two-dimensional slice—that forms the three-dimensional image by “loop[ing] through

each slice.” *Wills*, 38:22-24; *see also id.*, 38:39-39:9 (pseudocode step [4310], stating “Loop through each slice lengthwise ...”). In my opinion, because *Wills* discloses that the **depth measurements** of the **surface information** are determined by looping through multiple two-dimensional slices that make up the three-dimensional image captured of the **master key**, *Wills* discloses that “said **characteristics** of said **contour** are determined based on image data from at least said two or more views of said **master key**.”

96. Regarding (ii), in my opinion, *Wills* envisions extracting **depth measurements** of the **surface information** based on images captured of both sides of the **master key**. In particular, *Wills* envisions that, in some embodiments, the machine “prompts the operator to remove the **master key** from the [machine] and flip it over so that the milling on the reverse side can be scanned and used in the identification process.” *Wills*, 15:26-30. *Wills* explains that the reverse side would be scanned when “one side milling comparison” is insufficient to identify a reference key. *Id.*, 15:30-33. A POSA would have understood *Wills* as disclosing that the **groove geometry** of the reverse side of the **master key** would be used to identify a key blank if the **groove geometry** of the top side of the **master key** alone was insufficient to do so. In my opinion, a POSA would have understood *Wills* to disclose that, just as *Wills*’s computer subsystem analyzes the captured **image** to determine **depth measurements** of the milling on one side of the **master key** based on the **surface**

information, *Wills*'s computer subsystem likewise analyzes a captured image of the “reverse side” of the master key to determine depth measurements of the milling on the “reverse side” of the master key based on the surface information. Further, in my opinion, because *Wills* thus envisions extracting depth measurements of the surface information based on images captured of both sides of the master key, *Wills* discloses that “said characteristics of said contour are determined based on image data from at least said two or more views of said master key.”

97. In my opinion, *Wills* also discloses “calculat[ing] the geometry of the contour based on” this “data from at least said two or more views of said master key” because *Wills* envisions its computer subsystem (the claimed “logic”) determining these depth measurements of the surface information—either for the two-dimensional slices that make up the three-dimensional image or for images of both sides of the master key, as explained above.

98. *Wills*'s master key includes a tip and a blade, as shown in Figure 1A.

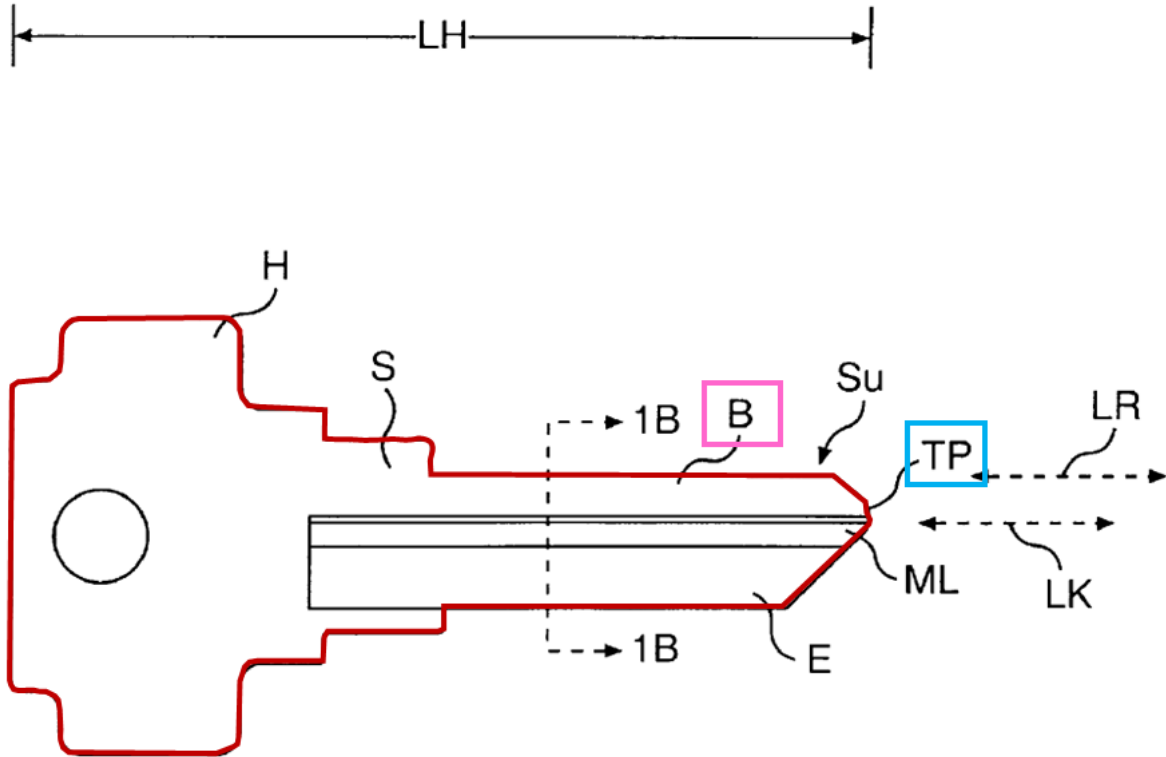


FIG. 1A

Wills, Figure 1A (annotated)

99. Further, as explained for claim 1[b], *Wills*'s blade includes a milling, or groove, as shown in Figure 7A. The milling has particular surface information, such as the depth, as shown in Figure 7B, which is a cross-section of Figure 7A along the line 7B–7B. *Wills*, 5:61-65, 11:59-63.

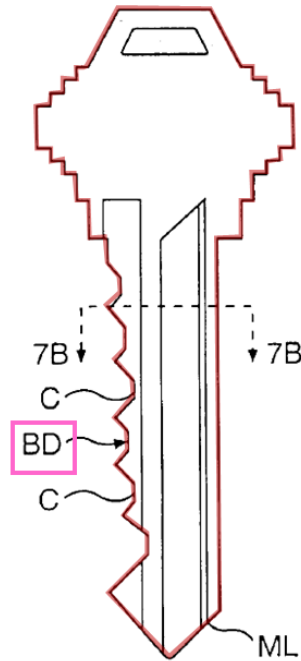


FIG. 7A

Wills, Figure 7A (annotated)

100. As *Wills* recognizes, “the light beam LB is inclined at an angle θ less than ninety degrees (90°)” to the blade of the master key, with the result that “the point of intersection with the key surface will vary in the direction of the length of the key ($\Delta\ell$), which is a function of the depth (Δd) of the milling pattern at that point,” namely, $\Delta d = (\Delta\ell)(\tan \theta)$. *Wills*, 12:55-65.

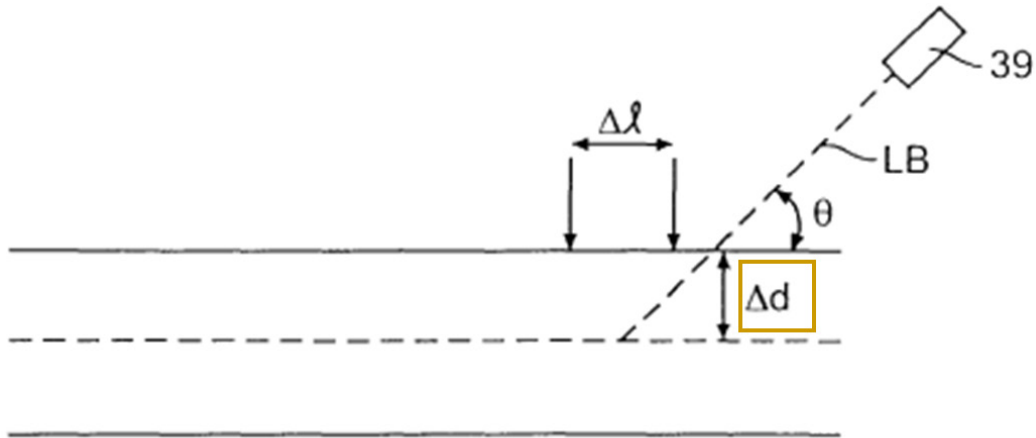


FIG. 10A

Wills, Figure 10A (annotated)

101. In this manner, in *Wills*, “[t]he intersection of the light beam line and the key surface are extracted to determine depth of milling across the key, which is shown in a simplified form in FIG[. 7D.” *Wills*, 13:1-3.

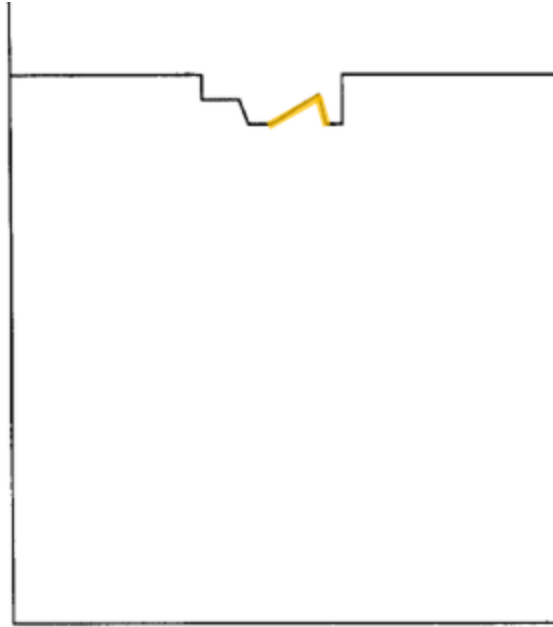
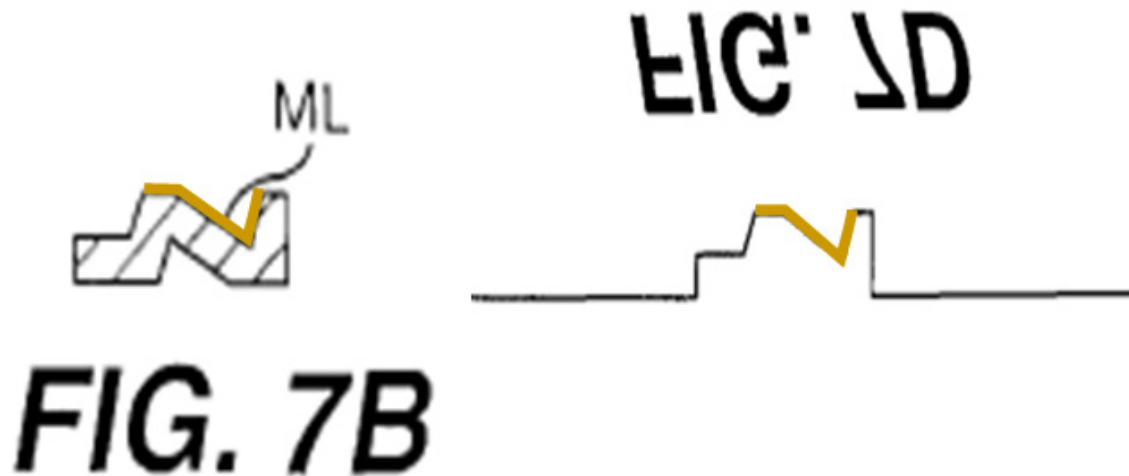


FIG. 7D

Wills, Figure 7D (annotated)

102. As I discussed above, Figure 7B is a cross-section of Figure 7A along the line 7B–7B. *Wills*, 5:61-65, 11:59-63. A comparison of Figure 7B and Figure 7D shows that the “intersection of the light beam line and the key surface” corresponds to the cross-section of the **master key**.



Wills, Figure 7B (annotated) and
Figure 7D (cropped, vertically flipped, and annotated)

103. In my opinion, the above comparison demonstrates that by calculating the **depth** of the milling, *Wills* discloses “the geometry of the **contour**” of the milling in the **master key**. As Figure 3 of the ’385 patent shows, the geometry of the **contour** in the ’385 patent, like the **depth** of the milling in *Wills*, is a geometry of the groove. ’385 patent, 5:37-38; *see also id.*, Figure 6 (showing “**contour** data related to **contours** of the groove” in Figure 3), Figure 7 (showing calculated “groove **contours**”); 4:64-66 (describing “geometric parameters of a given groove” including “size, location, angle, and other”), 5:64 (describing “groove geometry”).

104. It would have also been obvious for the modified *Wills* logic to determine characteristics of the contour and calculate the geometry of the contour based on data from a **tip end** image taught by *Cimino* and as obtained using mirrors

taught by *Shirley*. For example, *Wills*'s discloses determining dimensions such as length, and width using a silhouette image by indexing pixels of that image. *Wills*, 34:46-35:5. In particular, *Wills* discloses: "The means for obtaining the length 2350 calculates the length of the key from head to tip and the means for obtaining the head shape information 2360 calculates the width of the key at specified intervals." *Id.*, 35:1-5. *Wills* also discloses using "pseudo code" with functions "Profile()" and FindWidth() to "obtain the length and width of the key at respective intervals." *Id.*, 35:6-8; *see also id.*, 35:9-37:8.

105. In my opinion, an image of the **tip end** of **master key** as disclosed by *Cimino* would produce a silhouette type image. *Cimino* itself describes it as "an end-on cross-section image 35 of the front 2 of the key 1." *Cimino*, 4:18-20. In my opinion, a POSA would have found it obvious to use the techniques disclosed by *Wills* for calculating the length and width of the key from the silhouette image to determine the depth of the groove in the master key from the **tip end** image as taught by *Cimino*. Indeed, such techniques were well known in the art before the earliest priority date of the '385 patent. For example, *Bass* discloses "captur[ing] the image of the blade 32 of a master key 22" and that the "captured image may be analyzed by logic to quantify and specifically define the key pattern 36 of the master key," including "the depth, angle, and position of each tooth." *Bass*, ¶[0060]. Further, *Bass* discloses "record[ing] a tip view or cross-sectional view of the key 24" and that

“[i]nformation on the groove 34 may likewise be analyzed and compared by the logic to groove information stored in the database related to known key blanks 24.” *Id.*, ¶¶[0062]-[0063]; *see also id.*, ¶¶[0061], [0065]. A POSA would have been motivated to determine the **depth measurements** using the **tip end** image because as discussed above the **tip end** image may provide a more accurate representation of the groove **contour**. In my opinion, therefore, a POSA thus would have found it obvious for the modified *Wills* logic to determine characteristics of the contour and calculate the geometry of the **contour** based on the two-dimensional slices, based on images of both sides of the **master key**, and/or using the tip end image as taught by *Cimino* and *Shirley*, and would have had a reasonable expectation of success in doing so.

106. In my opinion, because *Wills* thus discloses its computer subsystem determining **depth measurements** of the **surface information** based on (i) at least two or more of the two-dimensional slices that make up the three-dimensional image captured of the **master key**, (ii) on images captured of both sides of the **master key**, or based on a tip end image as taught by *Cimino* and *Shirley*, and because *Wills* further discloses calculating, from those captured images, the **depth** of the milling in the **master key**, *Wills* discloses “said logic calculat[ing] the geometry of the **contour** based on data from at least said two or more views of said **master key**.”

107. In my opinion, POSA would have understood *Wills*’s computer

subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely “calculat[ing] the geometry of the **contour** based on data from at least said two or more views of said **master key**.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

2. Claim 2: The key identification system of claim 1, wherein said logic includes a database containing data related to characteristics of grooves of known key blanks.

108. *Wills* discloses that the “logic includes a database containing data related to **characteristics of grooves of known key blanks**” because it describes the computer subsystem (the claimed “logic”) storing the “surface information” for the reference keys, which includes, the **depth measurements of the reference keys**, in “a memory means such as a database.” *Wills*, 32:49-59 (“The surface information consists of depth measurements across the width of the key.”); *see also id.*, 33:37-

34:35 (example surface information for reference keys). A POSA would have understood the depth measurements of the reference keys to be “characteristics of grooves of known key blanks” because a POSA would have understood “characteristics” to encompass “depth measurements,” and a POSA would have recognized that “depth measurements,” like the other “surface information” stored in the database in *Wills*, are characteristics of the millings, or “grooves,” of the reference keys.

109. In my opinion, POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses that its computer subsystem “includes a database containing data related to characteristics of grooves of known key blanks.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. See Section VIII.

3. Claim 3: The key identification system of claim 1, wherein said imaging system includes a reflecting device.

110. *Wills* discloses that the “imaging system includes a reflecting device” because *Wills*’s machine employs a “mirror 29,” shown in Figure 9, that “reflects the image [of the master key] to the camera 28.” *Wills*, 7:47-48.

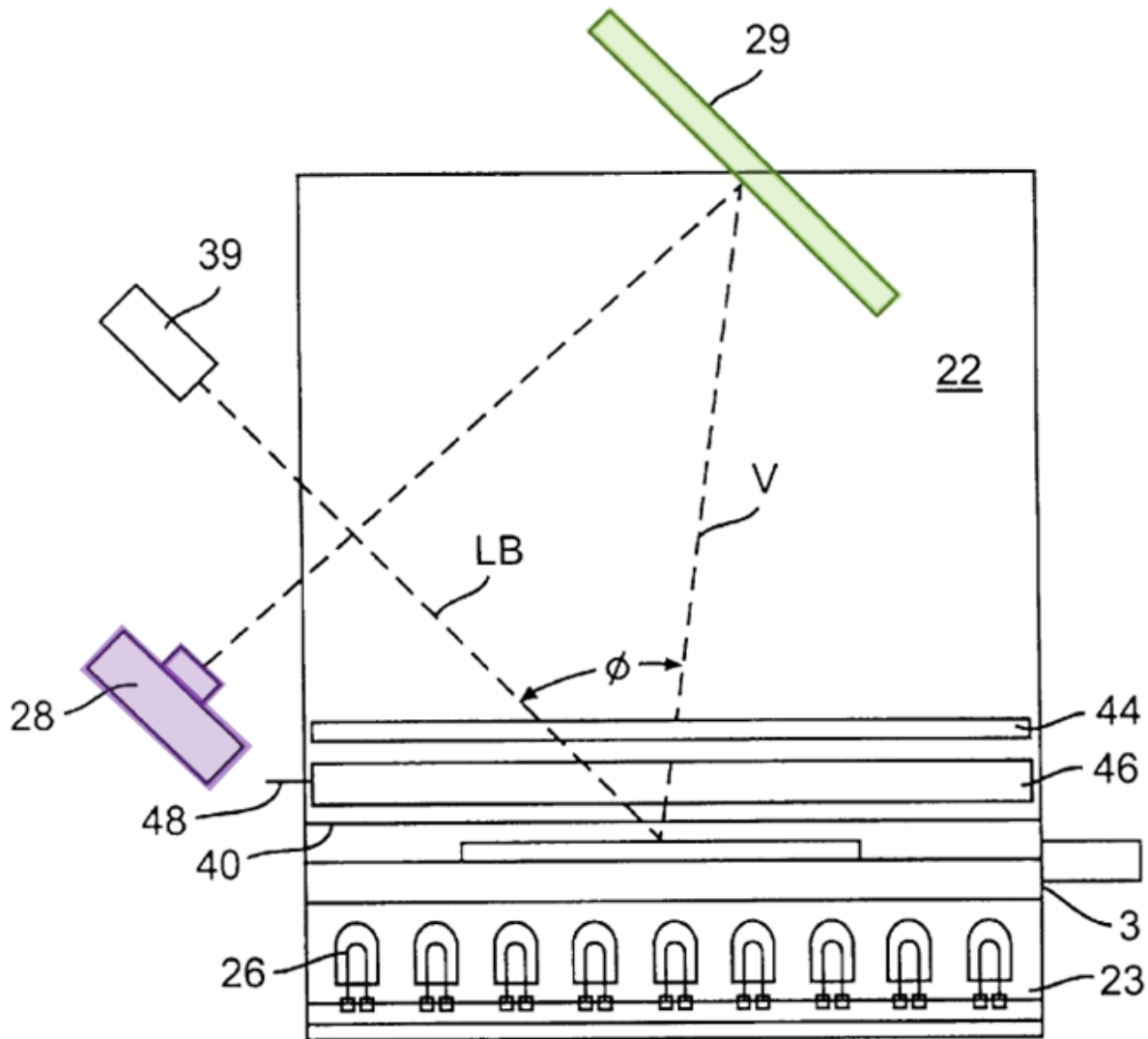


FIG. 9

Wills, Figure 9 (annotated).

4. Claim 4: The key identification system of claim 1, wherein said **imaging system includes a **light**.**

111. *Wills* discloses that the “**imaging system** includes a **light**” because *Wills*’s machine employs a “**light emitting means**,” as shown in Figure 9. *Wills*, 11:48-63.

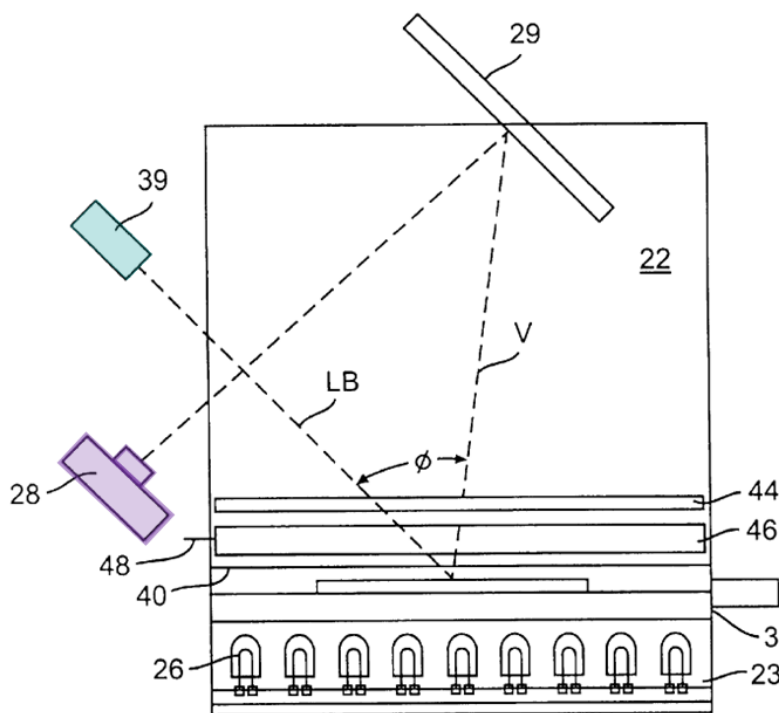


FIG. 9

Wills, Figure 9 (annotated).

112. Alternatively, *Wills* discloses that the “**imaging system** includes a **light**” because *Wills*’s machine employs an “array of **LEDs 26**,” as shown in Figure 9. *Wills*, 6:65-7:3.

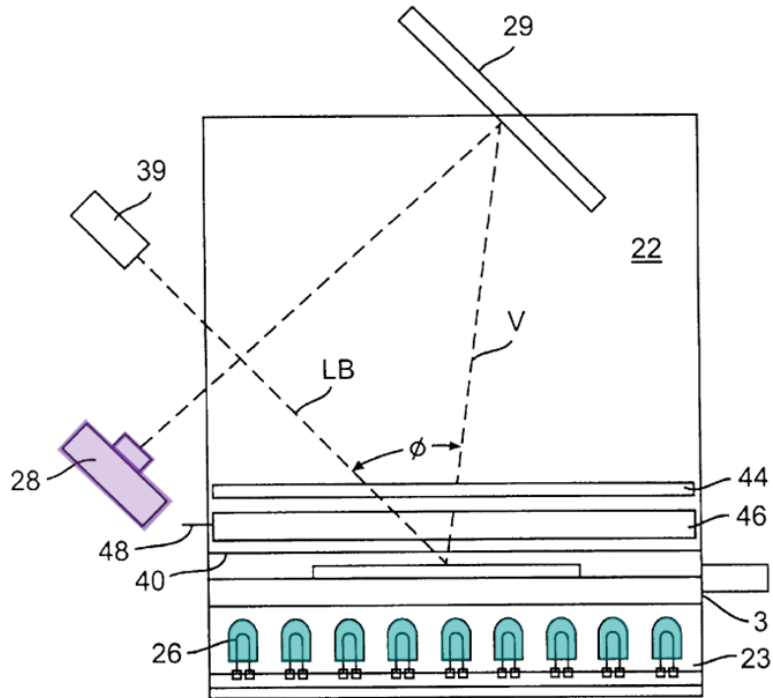


FIG. 9

Wills, Figure 9 (annotated).

5. **Claim 5: The key identification system of claim 4, wherein said light is directed toward said reflecting device.**

113. *Wills* discloses that the “light is directed toward said reflecting device” because, as Figure 9 shows, the light is “directed toward” the mirror when reflected off the master key and before being captured by the camera.

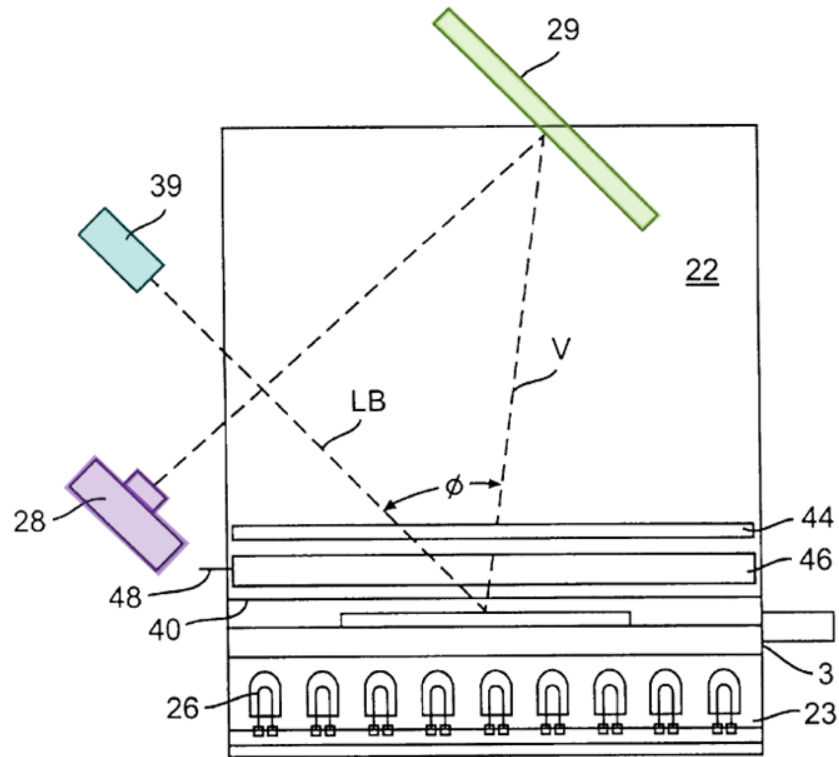


FIG. 9

Wills, Figure 9 (annotated).

114. Alternatively, *Wills* discloses that the “light is directed toward said reflecting device” because, as Figure 9 shows, the array of LEDs is “directed toward” the mirror.

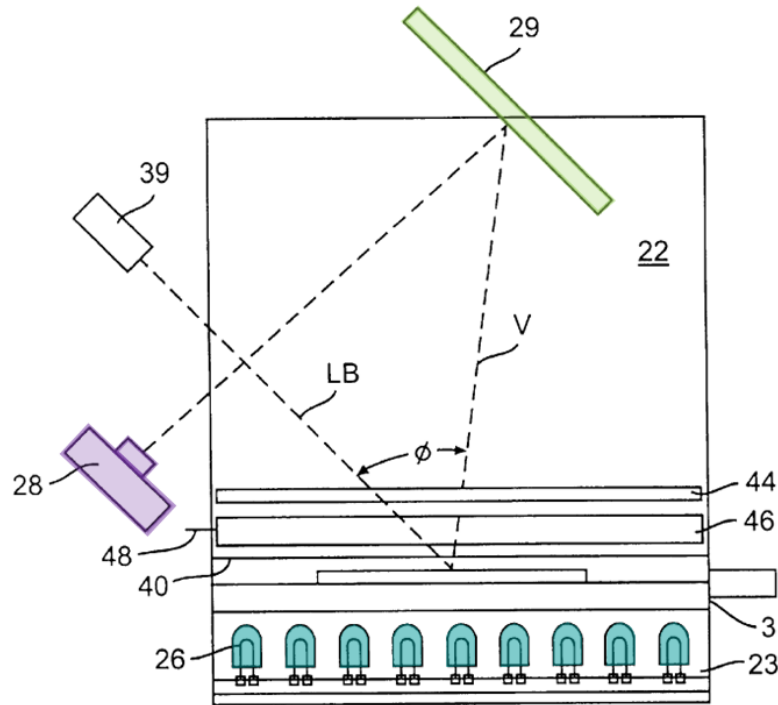


FIG. 9

Wills, Figure 9 (annotated).

6. Claim 7: The key identification system of claim 1, wherein said captured image is a digital image.

115. *Wills* discloses that the “captured image is a digital image” because *Wills* explains that the camera “captures the image of the master key and converts it into an electrical signal, which [a] digitizing means, or digitizing subsystem, converts into a digital image.” *Wills*, 8:10-13; *see also id.*, 8:46-54 (describing using the “digitizing means,” “digitizing subsystem,” and a “digital camera” for “the image of the light beam interfacing with the ... master key”), 12:40 (“the image of the light beam LB is captured and digitized”), 14:66-15:2 (“the digitized image of the light beam LB”). From *Wills*, a POSA would have understood that the two-

dimensional slices captured along the length of the key are thus “digital image[s]” and, accordingly, that the **three-dimensional representation** formed by stacking the digital two-dimensional slices is a “digital image” as well. Such digitizing of images would have been common and within the skill of a POSA, and the POSA would have recognized that such digitizing was known to allow the image to be analyzed for comparison with images of reference keys.

7. Claim 10: The key identification system of claim 1, wherein said logic accounts for tilting of said **master key with respect to said imaging system to determine **characteristics** of said **contour**.**

116. *Wills* discloses “account[ing] for tilting of said **master key** with respect to said imaging system to determine **characteristics** of said **contour**” because *Wills*’s machine accounts for in-plane movement of the **master key** with respect to the **camera** in extracting the **depth measurements** of the **surface information**.

117. A POSA would have understood “tilting” in the ’385 patent to encompass in-plane movement of the **master key**, as shown in Figure 14 below. ’385 patent, 7:18-20 (“With reference to FIG. 14, the key may be tilted or yawed in a plane perpendicular to the orientation of the outline camera 20.”). The ’385 patent seeks to account for tilting of the **master key** so that “[t]he **key** ... is not constrained to a particular orientation or position.” *Id.*, 7:17-18.

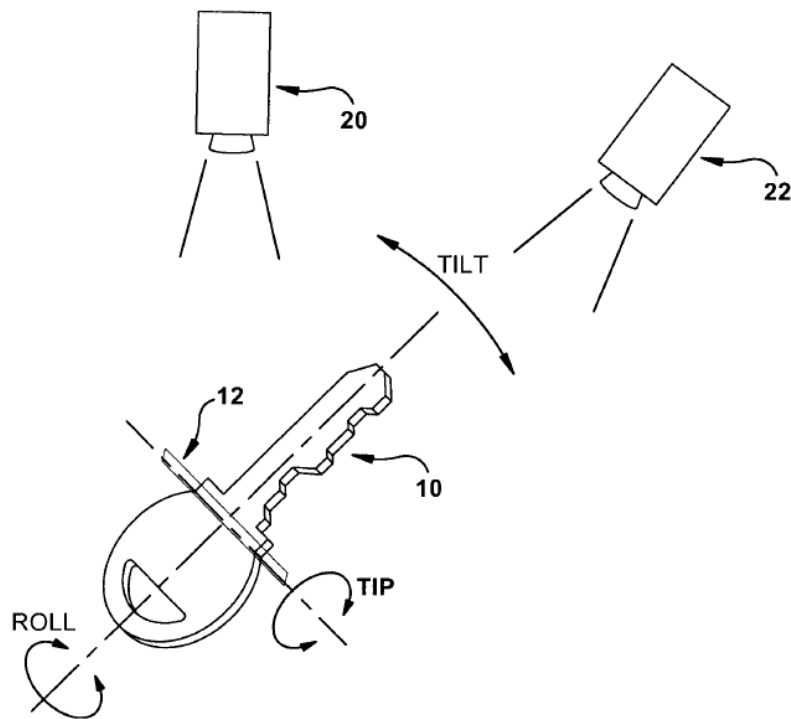


FIG. 14

'385 patent, Figure 14.

118. Similarly, in *Wills*'s machine, "[t]he image" of the **master key** "is converted by translating ... to a predetermined reference position and orientation, independent of the position at which the key is placed in" the machine. *Wills*, 9:35-38. In my opinion, a POSA would have understood "translating ... to a predetermined reference position and orientation" in *Wills* to describe in-plane movement of the **master key** akin to the "tilting" of the '385 patent. As *Wills* explains, this translating allows the "key information" of the **master key**, including the extracted **depth measurements** of the **surface information**, to be "standardized" so as

“to be comparable to” the information about the reference keys. *Id.*, 9:38-43. As a result, *Wills*’s machine, like the system of the ’385 patent, “does not require the master key to be precisely aligned to operate efficiently.” *Id.*, 7:29-31. A POSA would have recognized that accounting for “tilting” of the master key as recited in the ’385 patent, was known to facilitate comparison of the image of the master key and images of the reference keys, as *Wills* describes, especially in a machine like *Wills*’s where the master key, placed in a drawer, *Wills*, 7:4-8; 11:44-46, is likely to experience in-plane movement. In my own work at Hillman, such positional variations were recognized and addressed in machines in which the master key was laid upon a surface like *Wills*’s drawer.

119. In my opinion, a POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely “account[ing] for tilting of said

master key with respect to said imaging system to determine **characteristics** of said **contour**.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

- 8. Claim 13: The key identification system of claim 1, wherein said logic calculates the geometry of the **contour** as seen from a view of the **tip** parallel to the **blade** based on data from at least said two or more views of said **master key**.**

120. *Wills* in view of *Cimino* and *Shirley* teaches this additional feature. As explained for claim 1[c], *Wills* discloses “calculating the geometry of the **contour** ... based on image data from at least said two or more views of said **master key**.” *Wills*’s **master key** includes a **tip** and a **blade**, as shown in Figure 1A.

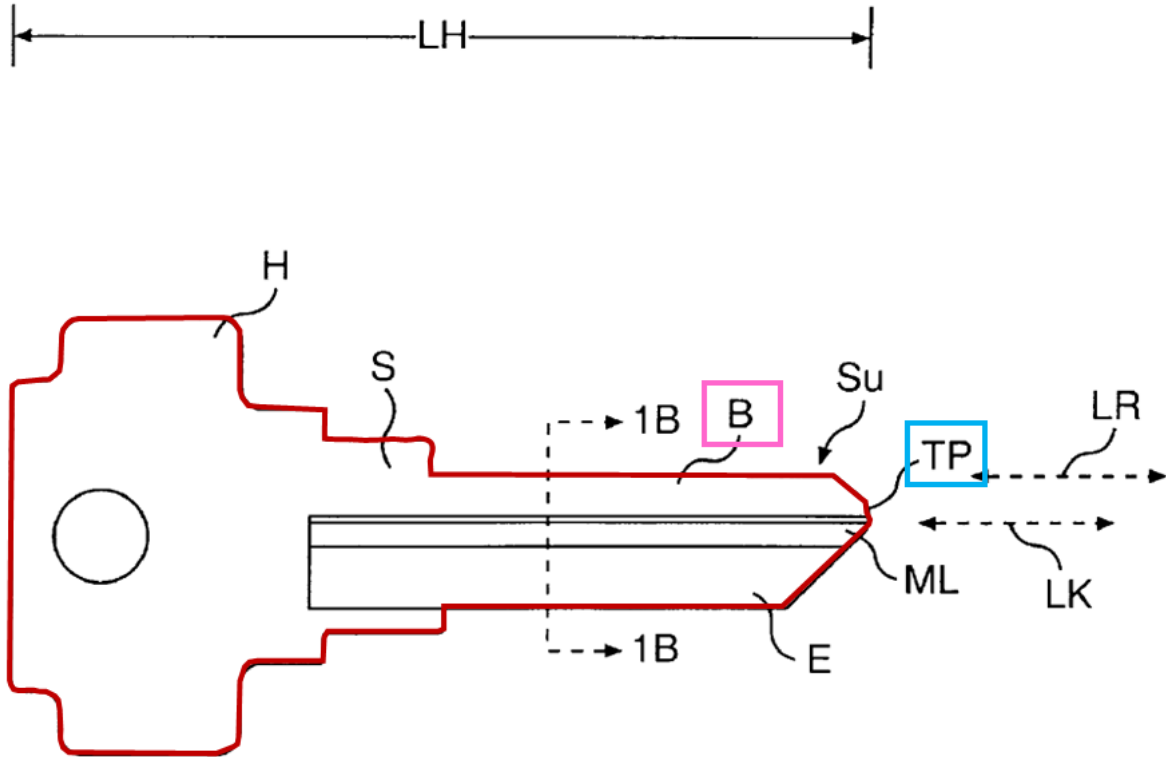


FIG. 1A

Wills, Figure 1A (annotated).

121. Further, as explained for claim 1[b], *Wills*'s **blade** includes a milling, or groove, as shown in Figure 7A. The milling has particular **surface information**, such as the **depth**, as shown in Figure 7B, which is a cross-section of Figure 7A along the line 7B–7B. *Wills*, 5:61-65, 11:59-63.

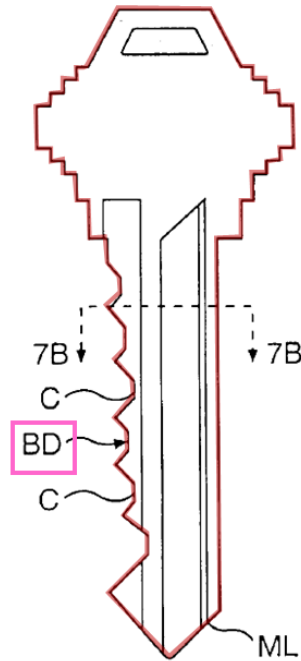


FIG. 7A

Wills, Figure 7A (annotated).

122. As *Wills* recognizes, “the light beam LB is inclined at an angle θ less than ninety degrees (90°)” to the blade of the master key, with the result that “the point of intersection with the key surface will vary in the direction of the length of the key ($\Delta\ell$), which is a function of the depth (Δd) of the milling pattern at that point,” namely, $\Delta d = (\Delta\ell)(\tan \theta)$. *Wills*, 12:55-65.

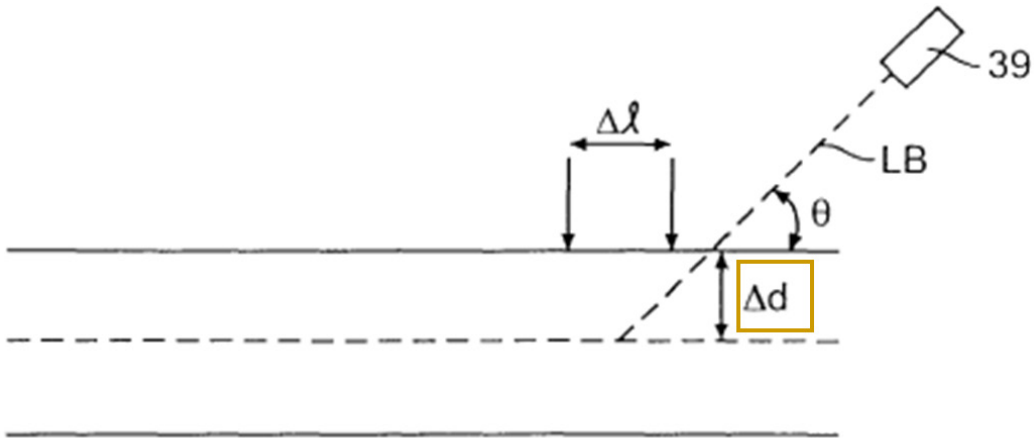


FIG. 10A

Wills, Figure 10A (annotated).

123. In this manner, in *Wills*, “[t]he intersection of the light beam line and the key surface are extracted to determine depth of milling across the key, which is shown in a simplified form in FIG[. 7D.” *Id.*, 13:1-3.

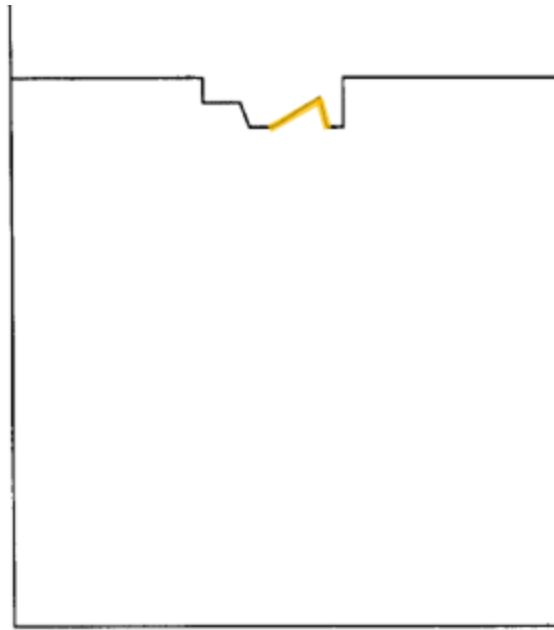
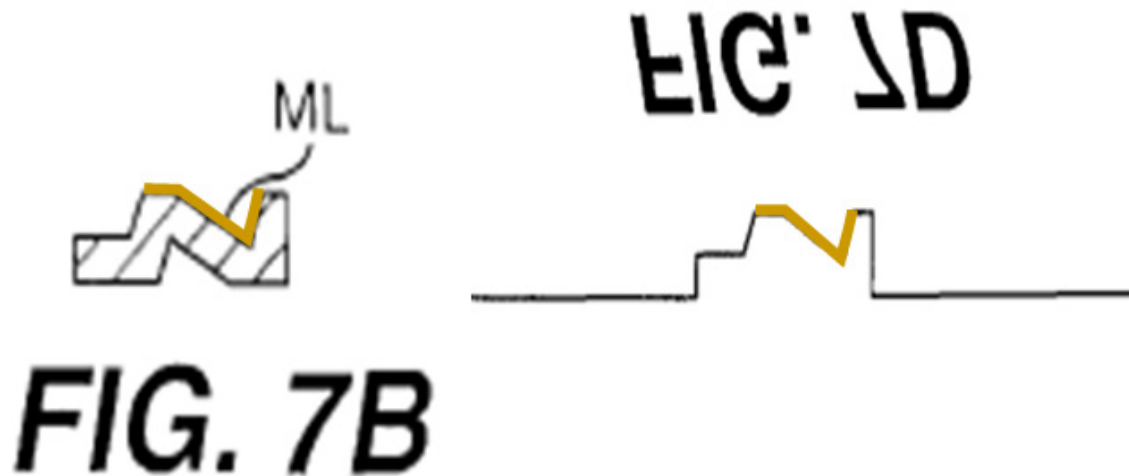


FIG. 7D

Wills, Figure 7D (annotated).

124. As noted above, Figure 7B is a cross-section of Figure 7A along the line 7B–7B. *Wills*, 5:61-65, 11:59-63. A POSA would have recognized from Figures 7A and 7B, such a cross-section is a view “as seen from a view of the **tip** parallel to the **blade**.” A comparison of Figure 7B—the view of the **tip** parallel to the **blade**—and Figure 7D—the result of *Wills*’s calculation from Figure 10A—shows that the “determine[d] **depth** of milling across the **key**” of Figure 10A is likewise “as seen from a view of the **tip** parallel to the **blade**.”



Wills, Figure 7B (annotated) and
Figure 7D (cropped, vertically flipped, and annotated).

125. In this manner, *Wills* describes calculating the **depth** of the milling in the **master key** as seen from a view of the **tip** parallel to the **blade**. And as explained with respect to claim 1[c], a POSA would have understood this calculated **depth** of the milling to be “the geometry of the **contour**.”

126. Because *Wills* thus discloses its computer subsystem determining **depth measurements** of the **surface information** based on (i) at least two or more of the two-dimensional slices that make up the three-dimensional image captured of the **master key** or (ii) on images captured of both sides of the **master key**, and *Wills* further discloses calculating, from those captured images, the **depth** of the milling in the **master key** as seen from a view of the **tip** parallel to the **blade**, *Wills* discloses “said logic calculat[ing] the geometry of the **contour** as seen from a view of the **tip**

parallel to the **blade** based on data from at least said two or more views of said **master key**.”

127. Further, as I explained for claim 1[c], a POSA would have found it obvious to capture a **tip end** view as taught by *Cimino*, using one or more mirrors as taught by *Shirley* in *Wills*’s machine. A POSA would have understood that the **tip end** view would represent a view of the **tip** parallel to the **blade**. As I explained for claim 1[c], a POSA would have been motivated to do so to realize the advantages of improved automation, accurate **contour** geometry determination, and/or the ability to confirm the **accuracy of an** identified key blank, using the view of the **tip** parallel to the blade as taught by *Cimino*.

128. As also explained for claim 1[c], in my opinion, a POSA would have found it obvious to use the techniques described in *Wills* for determining dimensions to calculate the geometry of the **contour** from the **tip end** image as taught by *Cimino*. And as I explained for claim 1[c], a POSA would have been motivated to do so to realize the advantages of improved automation, accurate **contour** geometry determination, and/or the ability to confirm the **contour** geometry or the identified key blank, using the **tip end** view that represents a view of the **tip** parallel to the **blade**.

129. In my opinion, POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example,

the '385 patent provides that the “logic” may take the form of “a memory device containing instructions.” '385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely “calculat[ing] the geometry of the **contour** as seen from a view of the **tip** parallel to the **blade** based on data from at least said two or more views of said **master key**.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

9. Claim 14: The key identification system of claim 1, wherein said logic calculates the geometry of the **contour as though the **tip** were squarely cut based on data from at least said two or more views of said **master key**.**

130. As explained for claim 1[c], *Wills* discloses its computer subsystem (the claimed “logic”) determining “**characteristics** of said **contour** ... based on image data from at least said two or more views of said **master key**” because *Wills* discloses determining **depth measurements** of the **surface information** based on at least two or more of the two-dimensional slices captured of the **master key**. And, as explained for claim 13, *Wills* discloses its computer subsystem (the claimed “logic”) “calculat[ing] the geometry of the **contour** ... based on” this “data from at least said

two or more views of said **master key**” because *Wills* envisions determining these **depth measurements** of the **surface information** for the two-dimensional slices that make up the three-dimensional image. *Wills* also discloses its computer subsystem (the claimed “logic”) “calculat[ing] the geometry of the **contour** as though the **tip** were squarely cut” because a POSA would have recognized that the two-dimensional slices, taken along the length of the **master key**, include at least two two-dimensional slices taken “as though the **tip** were squarely cut.”

131. A POSA would have understood “calculat[ing] the geometry of the **contour** as though the **tip** were squarely cut” to include calculating the geometry of the **contour** at a position along the length of the key at which the **tip** has not yet begun to taper, as illustrated by the **dotted line** added to Figure 1A of *Wills*. This is because a POSA would have recognized that calculating the geometry of the **contour** at such a position, before the **tip** has begun to taper, avoids the risk that the tapering will impact the “**characteristics** of said **contour**” sought to be determined. In my own work at Hillman, I was aware that the geometry of the **contour** of a milling in a **master key** is impacted by the tapering of the **master key** at its **tip**, and I designed key duplication machines to account for such tapering by capturing images elsewhere along the length of the **master key** where such tapering can be avoided. A POSA would have recognized the need to do the same in *Wills*’s machine and would have known how to calculate the geometry of the **contour** from the two-dimensional

slices taken along the length of the **master key** such that the tapering was avoided.

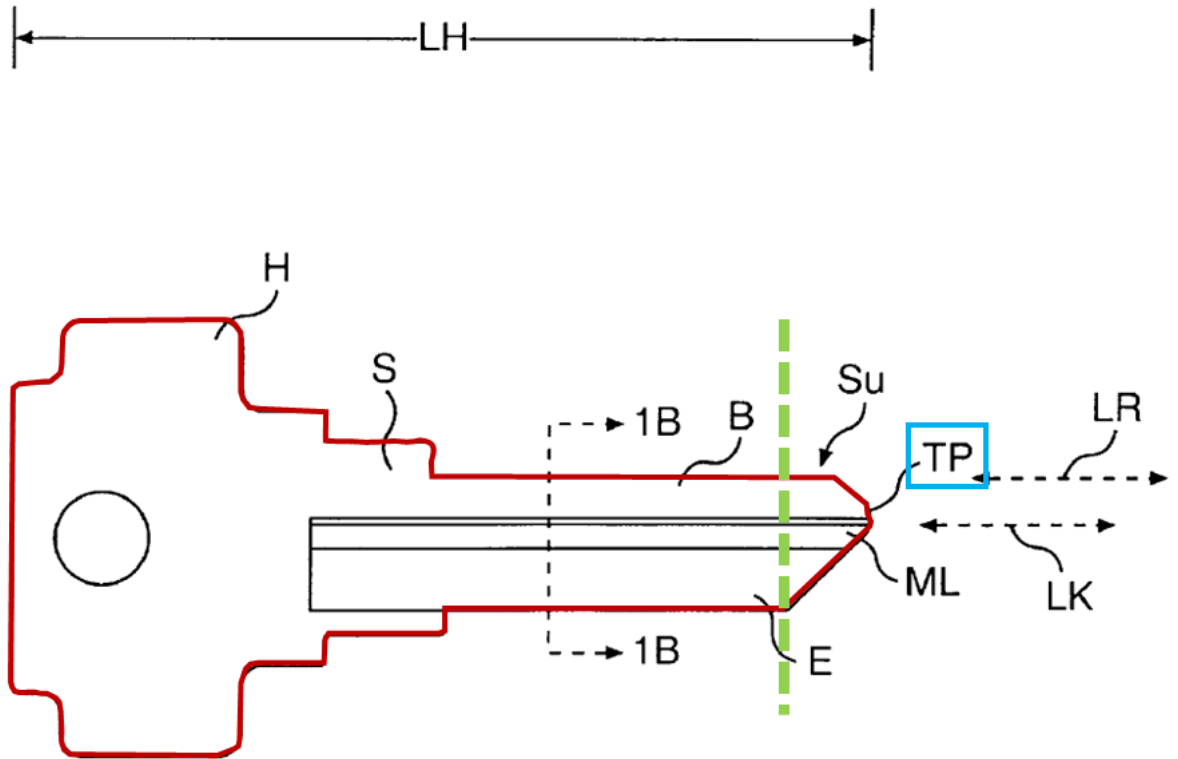


FIG. 1A

Wills, Figure 1A (annotated).

132. Because in *Wills* the two-dimensional slices are captured “along the length of the **key**,” *Wills*, 15:34-42, a POSA would have recognized, the two-dimensional slices include those captured at a position along the length of the key at which the **tip** has not yet begun to taper, that is, “as though the **tip** were squarely cut.”

133. Because *Wills* thus discloses its computer subsystem determining the **depth measurements** of the **surface information** for the two-dimensional slices that

make up the three-dimensional image of the **master key**, and because a POSA would have recognized that the two-dimensional slices include those captured at a position along the length of the key at which the **tip** has not yet begun to taper, in my opinion a POSA would have understood *Wills* to disclose “said logic calculat[ing] the geometry of the **contour** as though the **tip** were squarely cut based on data from at least said two or more views of said **master key**.”

134. As explained for claim 1[c], a POSA would have found it obvious to capture a **tip end** view as taught by *Cimino*, using one or more mirrors as taught by *Shirley* in *Wills*’s machine. A POSA would have understood that the **tip end** view would represent a view of the master key as though it were squarely cut. This is because as *Cimino* explains the tip end view provides “an end-on cross-section image ... of the front ... of the key.” *Cimino*, 4:19-20. Further, as explained for claim 1[c], a POSA would have found it obvious to use the techniques described in *Wills* for determining dimensions to determine depth information from the tip end image as taught by *Cimino*. A POSA would have been motivated to do so to realize the advantages of improved automation, accurate **contour** geometry determination, and/or the ability to confirm the **contour** geometry or the identified key blank, using the view of the **tip** parallel to the **blade**.

135. In my opinion, POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is

consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely “calculate[ing] the geometry of the **contour** as though the **tip** were squarely cut based on data from at least said two or more views of said **master key**.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

10. Claim 15: The key identification system of claim 1 further comprising a key holder configured to hold said **master key.**

136. *Wills* discloses “a key holder configured to hold said **master key**” because *Wills*’s machine includes a “supporting means” for the **master key**, such as a “drawer 30” that has “a bottom 32 against which one side of the **master key** is disposed.” *Wills*, 7:4-8; 11:44-46 (“the **master key** remains on the supporting means, specifically on the drawer 30” during the surface information analysis”). *Wills*’s drawer is consistent with one way in which the “key holder” is described in the ’385 patent, namely, as “any device capable of holding or supporting a master key.” ’385

patent, 3:67-4:1.

11. Claim 16: The key identification system of claim 15, wherein said key holder includes a lower support.

137. *Wills* discloses that the “key holder includes a lower support” because *Wills*’s “supporting means” for the master key has “a bottom 32 against which one side of the master key is disposed.” *Wills*, 7:4-8; 11:44-46 (“the master key remains on the supporting means, specifically on the drawer 30” during the surface information analysis). The bottom 32 of *Wills* corresponds to the claimed “lower support.”

12. Claim 20: The key identification system of claim 1, wherein one of said views of said master key includes a view from an angle between perpendicular and parallel to the blade of said master key and not including perpendicular or parallel to the blade of said master key.

138. *Wills* discloses and/or renders obvious that “one of said views of said master key includes a view from an angle between perpendicular and parallel to the blade of said master key and not including perpendicular or parallel to the blade of said master key” because *Wills*’s machine captures an image of the master key at a range of angles, including “an angle between perpendicular and parallel to the blade of the master key and not including perpendicular or parallel to the blade of the master key.”

139. As Figure 9 shows, *Wills* envisions its machine capturing an image of “the side of the master key ... along a viewing axis V.” *Wills*, 11:66-12:1. *Wills*

envisions a range of angles for the viewing axis V, including an **angle** between perpendicular and parallel to the side of the **master key** and not including perpendicular or parallel to the side of the **master key**.

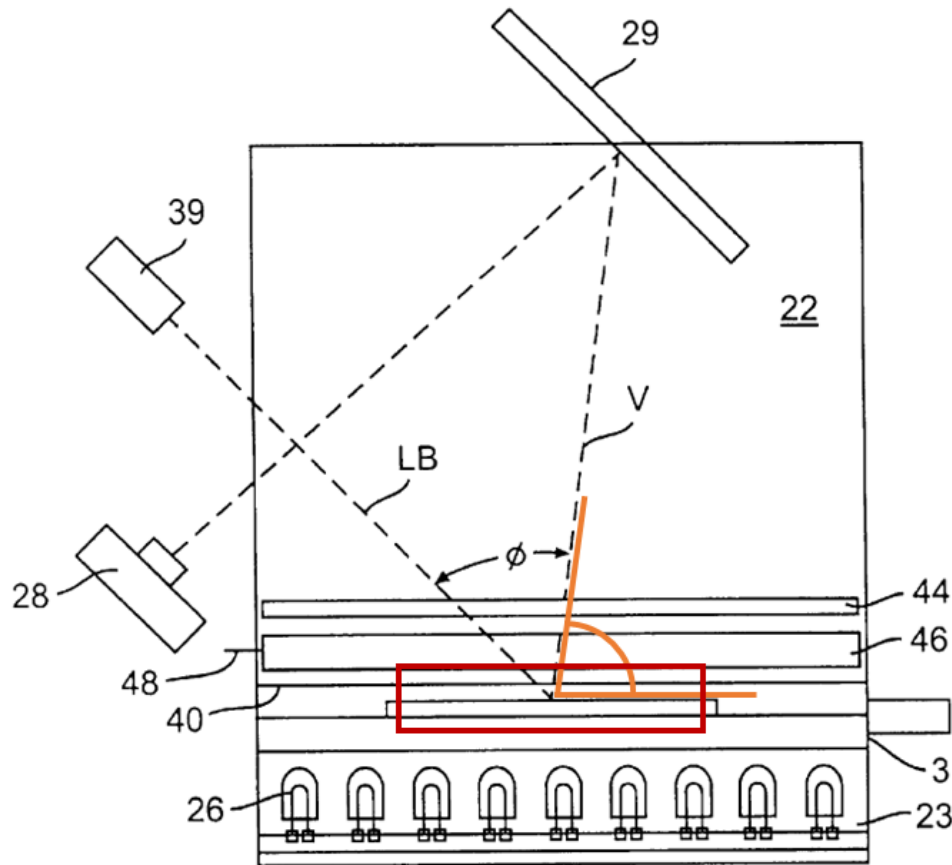


FIG. 9

Wills, Figure 9 (annotated).

140. In particular, as one example, *Wills* proposes that an **angle** at which the laser beam LB (shown in Figure 9 below) strikes the **master key** be “ten to eighty degrees (10°-80°)” relative to the side “of the **master key**,” and that the angle Φ between the laser beam LB and the viewing axis V be, for example, “sixty degrees

(60°).” *Wills*, 12:12-25. Thus, as illustrated below, *Wills* contemplates an embodiment in which, for example, the angle at which the laser beam LB strikes the master key is 50° relative to the side of the master key, and the angle Φ between the laser beam LB and the viewing axis V is 60°, such that the angle between the viewing axis V and the side of the master key is 70°. *Id.*

141. A POSA would have recognized from *Wills* that the side of the master key is co-planar with “the blade of the master key,” such that the angle between the viewing axis V and the side of the master key is likewise the angle between the viewing axis V and “the blade of the master key.” As Figure 7A shows, the blade “BD” of the master key in *Wills* is co-planar with one side of the master key, and the blade includes a milling “ML”. *Wills*, 5:11-24, 5:56-59. It is this side of the master key—that is, the side including the co-planar blade and its milling—with which the light beam interfaces to capture the image.

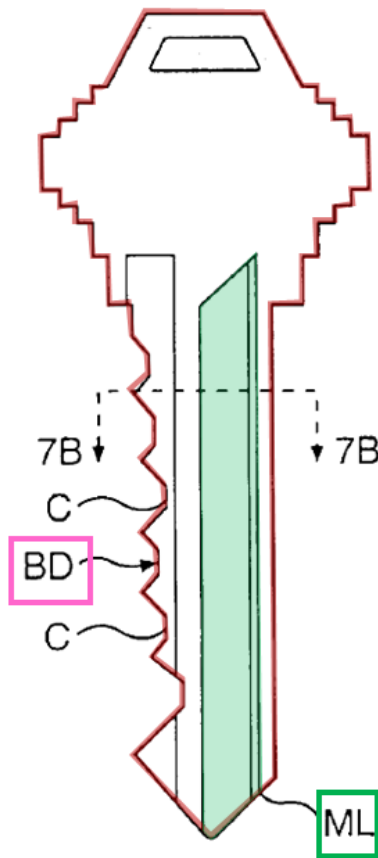


FIG. 7A

Wills, Figure 7A (annotated).

142. As *Wills* explains, the machine includes a “drawer,” and “one side of the **master key** is disposed” on the “bottom” of the “drawer.” *Wills*, 7:5-8, 11:44-46. The other side of the **master key** faces upward, such that “the light beam LB interfaces with the side of the **master key**.” *Id.*, 11:46-49. In particular, as Figures 7B and 7D show, the light beam interfaces with the **milling** in the **blade**, as the captured **image** reflects.

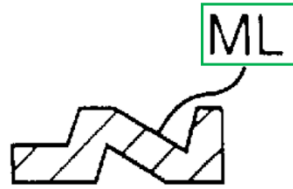


FIG. 7B

Wills, Figure 7B (annotated).

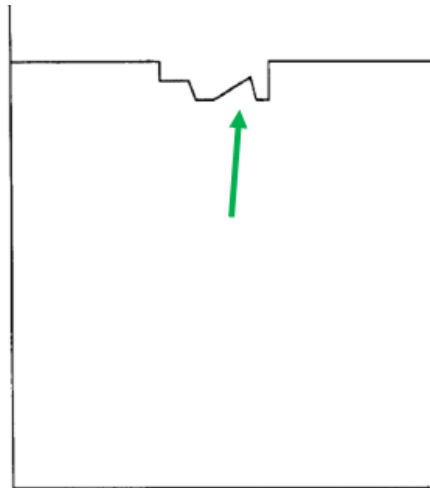


FIG. 7D

Wills, Figure 7D (cropped and annotated).

143. Because a POSA would thus have understood from *Wills* that the **image** is captured at an **angle** between perpendicular and parallel to the side of the **master key** and not including perpendicular or parallel to the side of the **master key**, and would further have understood from *Wills* that the side of the **master key** captured in the **image** is co-planar with the **blade** of the **master key**, a POSA would have

understood from *Wills* that the image is captured “a view from an **angle** between perpendicular and parallel to the **blade** of said **master key** and not including perpendicular or parallel to the **blade** of said **master key**.”

144. Because the 70° **angle** between the viewing axis V and the **blade** of the **master key** is between perpendicular (90°) and parallel (0°) to the **blade** of the **master key**, a POSA would have understood that *Wills* discloses and/or would have rendered obvious that this **angle** is “between perpendicular and parallel to the [side] of said **master key** and not including perpendicular or parallel to the [side] of said **master key**.”

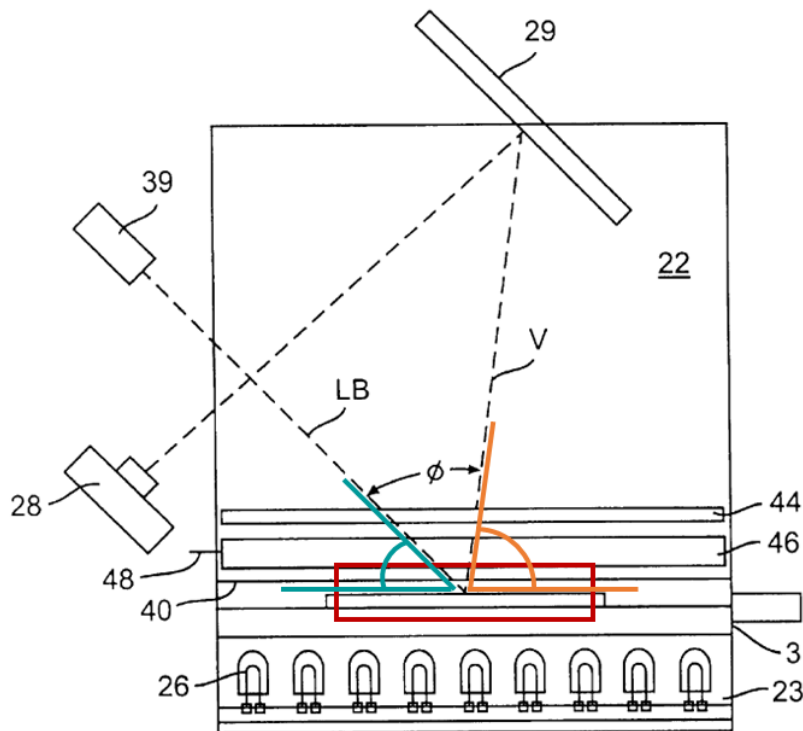


FIG. 9

Wills, Figure 9 (annotated).

145. I have been told that a claimed range is anticipated if one of the values in the range is in the prior art. Here, at least one angle in the range “between perpendicular and parallel to the [side] of said **master key** and not including perpendicular or parallel to the [side] of said **master key**” is disclosed by *Wills*, as shown above.

146. I have also been told that where a range is disclosed in the prior art, and the claimed invention falls within that range, there is a presumption of obviousness. I understand that this presumption is only overcome where (1) the prior art teaches away from the claimed invention or (2) there are new and unexpected results relative to the prior art. In my opinion, *Wills* renders the claimed angle obvious, because the claimed angle falls within the range disclosed by *Wills* and neither of (1) or (2) is present here.

147. Regarding (1), *Wills* not only does not teach away from “an **angle** between perpendicular and parallel to the **blade** of said **master key** and not including perpendicular or parallel to the **blade** of said **master key**,” *Wills* recognizes the value of such an angle for the viewing axis V. In particular, *Wills* recognizes that placing the camera somewhere other than directly overhead the key (which would result in a viewing axis V “perpendicular ... to the **blade** of said **master key**”) can require a larger machine to accommodate the focal length of the camera. *Wills*, 7:39-50. For this reason, *Wills* proposes employing the “mirror 29” shown in Figure 9, “to

minimize the size of the machine[.]” *Id.* Notably, *Wills*’s configuration employing the mirror is consistent with one way the “imaging system” and the “angle” are described in the ’385 patent. For example, the ’385 patent envisions an embodiment in which, as in *Wills*, a camera and a mirror are used together “to allow a single camera at a remote position to capture multiple angles of the master key, including angles of the tip 14.” ’385 patent, 5:45-48.

148. Regarding (2), capturing the image at “an angle between perpendicular and parallel to the blade of said master key and not including perpendicular or parallel to the blade of said master key” does not create any new and unexpected results not recognized by *Wills*. Rather, *Wills*, like the ’385 patent, recognizes that the angle at which the image is captured must be selected to ensure surface information about the master key can be discerned. *Compare Wills*, 12:4-8 (“If the viewing axis V and the light beam LB were parallel, then the segment would appear linear and no information would be easily obtained about the surface of the key.”), with ’385 patent, 5:14-17 (“Neither overhead scanning of the groove 11 nor parallel scanning of the groove 11 provide sufficient contrast between the groove 11 and the rest of the key 10 to effectively determine certain parameters of the groove 11.”).

149. Thus, a POSA would have understood *Wills* to describe a range of angles for the viewing axis V that includes the “angle between perpendicular and parallel to said blade of the master key and not including perpendicular or parallel

to the **blade** of said **master key**,” and in my opinion this range discloses and/or would have rendered obvious that “one of said views of said **master key** includes a view from an **angle** between perpendicular and parallel to the **blade** of said **master key** and not including perpendicular or parallel to the **blade** of said **master key**.”

13. Claim 21: The key identification system of claim 1, wherein the captured **image of said **tip** includes a **contour** of a **groove** in said **master key**.**

150. As explained for claim 1[a], *Wills* discloses “captur[ing] an **image** of the **tip** of a **master key**,” and that the “**image** includes a **contour**.” *Wills* also discloses that the “**contour**” is “a **contour** of a **groove** in said **master key**” because the captured **image** in *Wills*—whether the **two-dimensional slice** captured at the **tip** of the **master key** or the resulting **three-dimensional representation**, which would include the **tip** of the **master key**, as discussed for claim 1[a]—includes **surface information**, including a **depth**, of the **milling** in the **master key**.

151. As Figure 7A shows, *Wills*’s **master key** includes the **blade** in which is formed the **milling**, which *Wills* describes as “a longitudinally-extending **groove** ... in the **blade**.” *Id.*, 5:22-24, 5:56-59.

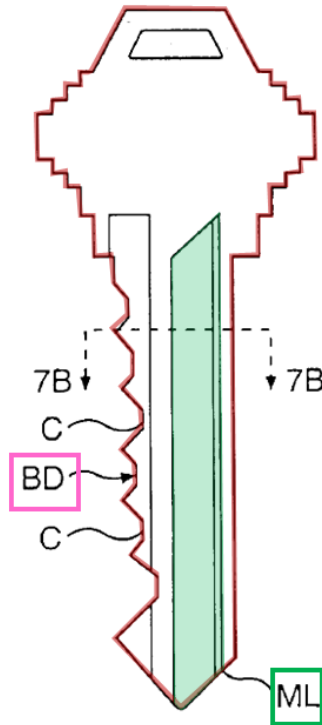


FIG. 7A

Wills, Figure 7A (annotated).

152. The **milling** of the **master key** in Figure 7A has particular “**surface information**,” such as a “**depth**,” as shown in Figure 7B, which is a cross-section of Figure 7A. *Wills*, 5:61-65, 11:59-63.

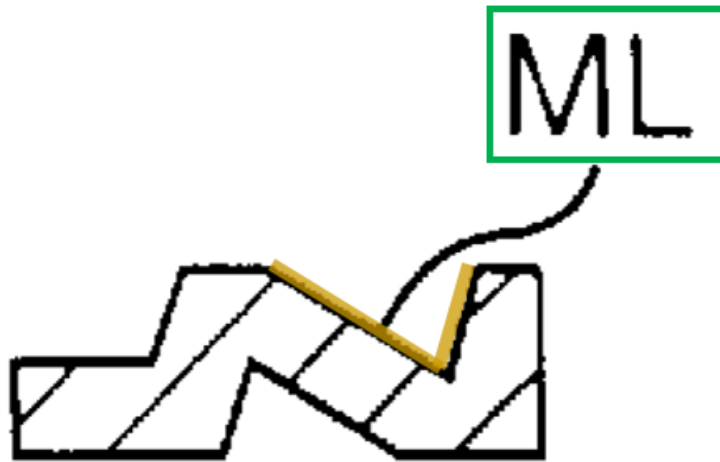


FIG. 7B

Wills, Figure 7B (annotated).

153. In my opinion, a POSA would have understood the **surface information**, such as the **depth**, of the **milling** of *Wills*’s **master key** to be a “a **contour** of a **groove** in said **master key**.” This is because, as Figure 3 of the ’385 patent shows, the **contour** of the **groove** in the ’385 patent, like the **surface information** of the **milling** in *Wills*, is a physical geometry of the **groove**. ’385 patent, 5:37-38; *see also id.*, Figure 6 (showing “**contour** data related to **contours** of the **groove**” in Figure 3), Figure 7 (showing calculated “**groove contours**”). 4:63-66 (describing

“[c]haracteristics of the **grooves**,” including “the size, location, angle, and other geometric parameters of a given **groove**”), 5:41-43 (describing “**groove** geometry”).

14. Claim 22: The key identification system of claim 1, wherein the logic is configured to shift data related to said **characteristics of said **contour** to compare with said **known key blank characteristics**.**

154. *Wills* discloses that “the logic is configured to shift data related to said **characteristics** of said **contour** to compare with said **known key blank characteristics**” because *Wills* describes its computer subsystem (the claimed “logic”) “translating” the image data of the captured image—from which the **depth measurements** of the **surface information** are determined—to facilitate comparison with the **depth measurements for the reference keys**.

155. In *Wills*, the captured image data is “converted” by the computer subsystem “by translating ... to a predetermined reference position and orientation, independent of the position at which the key is placed in” the machine.” *Wills*, 9:35-38. A POSA would have understood such translating of the captured image data to be “shift[ing] data related to said **characteristics** of said **contour**” because a POSA would have understood “translating” to be synonymous with “shift[ing]” and the **depth measurements** of the **surface information** (which disclose “said **characteristics** of said **contour**,” as explained for claim 1[b]) are determined from the captured image data, meaning the captured image data is “data related to” the **depth measurements** of the **surface information**. Further, a POSA would have understood

from *Wills* that such translating is done “to compare with said **known key blank characteristics**” because *Wills* explains that, through such translating, “key information” from the image data—which a POSA would have understood includes the **depth measurements** of the **surface information** determined from the captured image data—“is standardized to be comparable to **other key data** in [the] memory subsystem,” which *Wills* explains includes the “**depth measurements across the width of the [reference] key.**” *Wills*, 9:38-40, 32:58-59; *see also id.*, 15:2-5 (“The memory means also stores information about the light beam LB interfacing with each of the reference keys . . .”).

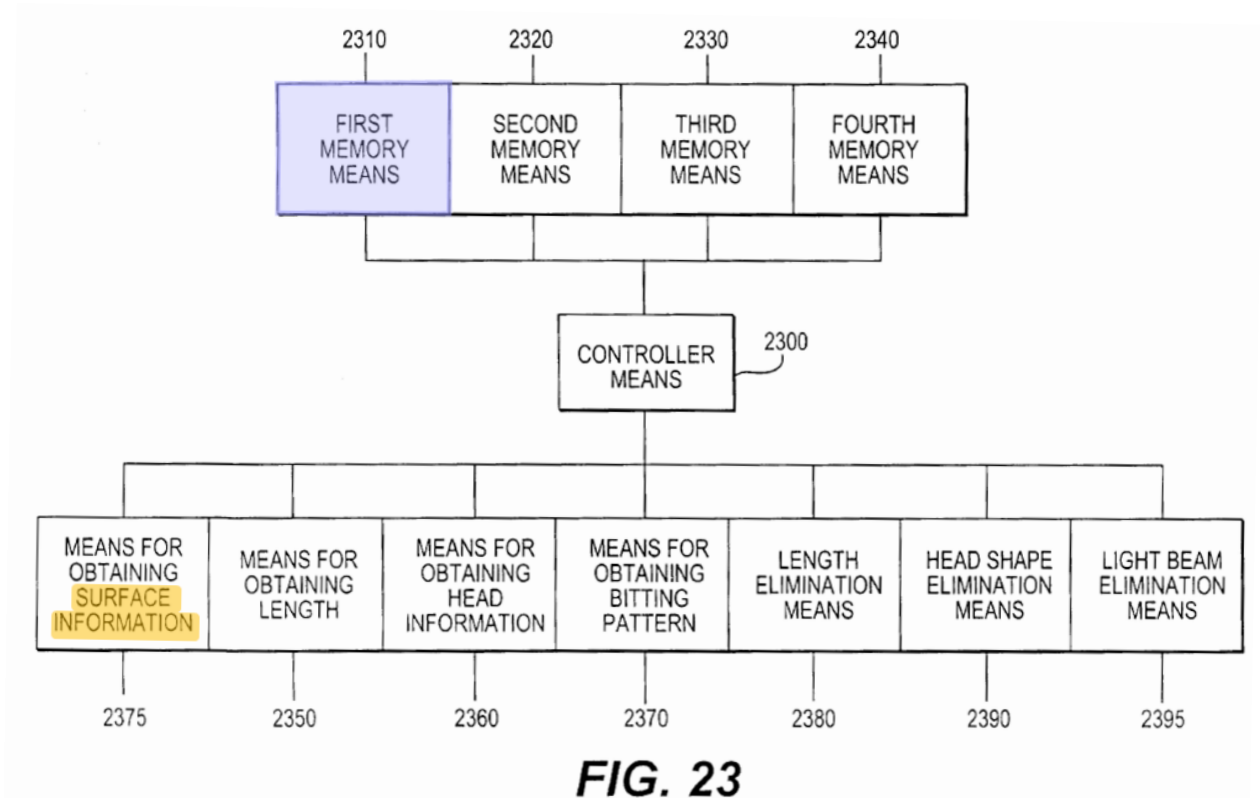
156. In my opinion, a POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely “shift[ing] data related to said **characteristics** of said **contour** to compare with said **known key blank characteristics.**”

For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

15. Claim 23: The key identification system of claim 1, wherein said logic includes a tolerance range for each **characteristic of said **master key** to determine whether a master key passes or fails to match a known key blank.**

157. *Wills* discloses that “said logic includes a tolerance range for each **characteristic** of said **master key** to determine whether a master key passes or fails to match a known key blank” because *Wills* envisions its computer subsystem (the claimed “logic”) eliminating potential reference keys that “deviate more than a desired value” from the **depth measurements** of the **master key**. *Wills*, 15:6–12.

158. As explained for claim 1[b], *Wills*’s computer subsystem, shown in Figure 23, includes “means for obtaining **surface information 2375**” that “extracts **depth measurements**” for the **master key** and a “light beam elimination means 2395” that compares the **depth measurements** for the **master key** with the **depth measurements for the reference keys**. *Wills*, 31:44-47, 32:1-2, 37:16-19.



Wills, Figure 23 (annotated).

159. As part of this comparison of the **depth measurements** for the **master key** with the **depth measurements for the reference keys**, *Wills* explains, the light beam elimination means “eliminates reference keys that deviate more than a desired value when compared with the master key.” *Wills*, 15:6-12. Because the light beam elimination means in *Wills* thus eliminates reference keys based on the “desired value” of deviation between the **depth measurements** of the **master key** and the **depth measurements for the reference keys**, a POSA would have understood *Wills*’s “desired value” to be “a tolerance range for” the **depth measurements** of the **master key** that *Wills*’s machine uses “to determine whether a master key passes or fails to

match a known key blank.”

160. In my opinion, POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses that its computer subsystem “includes a tolerance range for each characteristic of said master key to determine whether a master key passes or fails to match a known key blank.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

16. Claim 24

161. *Wills* in view of *Cimino* and *Shirley* renders obvious claim 24.

a. 24[p] A key identification system comprising:

162. To the extent this preamble is limiting, in my opinion, *Wills* discloses this limitation for the same reasons discussed in claim 1[p].

- b. 24[a] an imaging system including a camera in a first position configured to directly capture at least one image of one side of a master key, wherein said image includes a contour;

163. In my opinion, *Wills* discloses this limitation for the same reasons discussed in claim 1[a]. For example, *Wills* discloses that “camera 28 can be mounted vertically over the drawer 30.” *Wills*, 7:41-42. As illustrated in Fig. 8 of *Wills*, “camera 28,” positioned vertically above the master key, is configured to directly (e.g., without the use of a mirror) capture at least one image of one side (e.g., side facing camera 28) of the master key. *Wills*, Fig. 8.

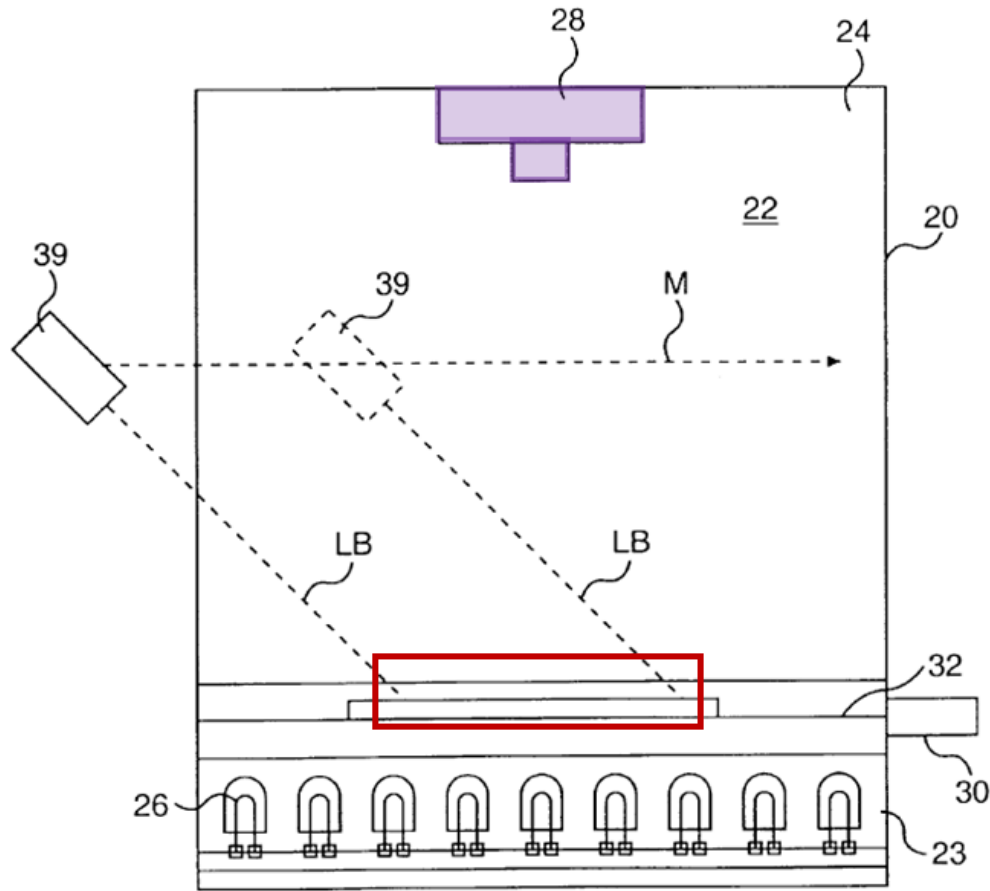


FIG. 8

Wills, Figure 8 (annotated)

164. And as I explained for claim 1[a], the at least one image includes a **contour**.

- a. 24[b] at least one **mirror** positioned to allow said **camera** to capture at least one image of a second side of a **master key** from a second position wherein the second position is from a different angle than the first position; and

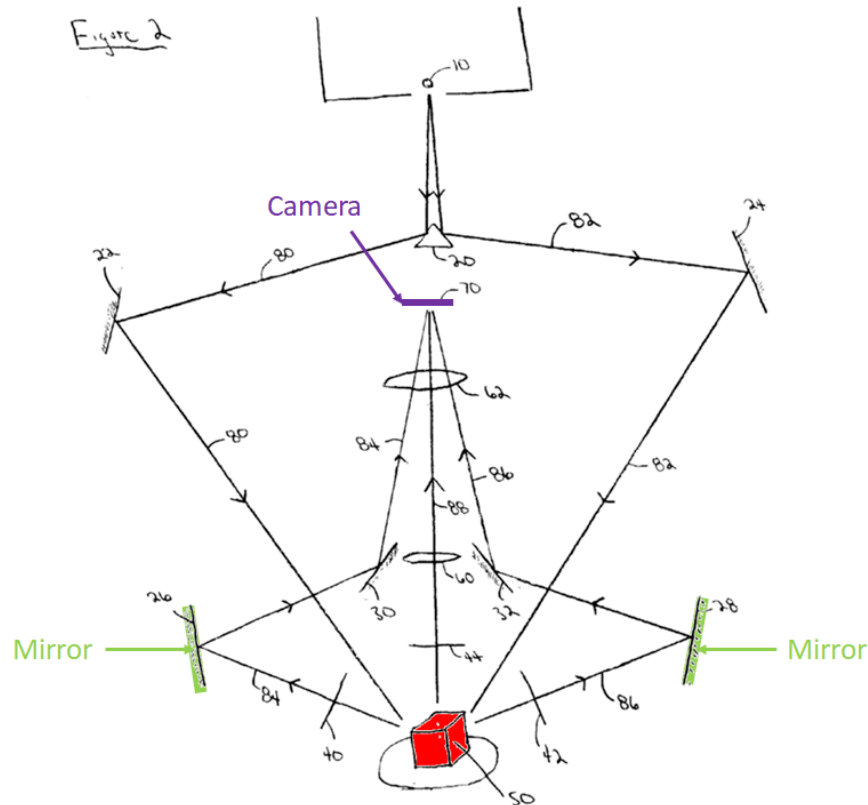
165. *Wills* in view of *Cimino* and *Shirley* teaches “at least one **mirror**

positioned to allow said camera to capture at least one image of a second side of a master key from a second position wherein the second position is from a different angle than the first position.” As I explained for claim 1[c], like *Wills*, *Shirley* discloses imaging a top side of object 50 (e.g., image 88) directly without a mirror, using detector 70. *Shirley*, ¶[0025]; *id.*, ¶[0022] (“The detector 70 is typically a CCD”). A POSA would have understood that *Shirley*’s CCD (e.g., charge coupled device) is a camera. In *Shirley*, image 88 is obtained without using a mirror. In my own work at Hillman, I designed machines that used cameras including charge coupled devices (CCDs) for imaging keys.

166. As I also explained for claim 1[c], *Shirley* discloses “at least one mirror positioned to allow said camera to capture at least one image of a second side of a master key from a second position wherein the second position is from a different angle than the first position.” For example, *Shirley* discloses an “image 84 formed by radiation reflected from the first surface of the object 50 is directed to a second mirror 26, which transmits the radiation to a third mirror 30 [that] directs the image 84 to the detector 70.” *Id.* ¶[0024]. *Shirley* similarly discloses an “image 86 formed by radiation reflected from a second surface of the object 50 is directed to a fifth mirror 28, which transmits the radiation to a sixth mirror 32 [that] directs image 86 to the detector 70.” *Id.*, ¶[0025]. *Shirley* also discloses “optical switches 40 and 42 are positioned to turn off either optical path, thus precluding radiation from

reaching the detector 70.” *Id.*, ¶[0021]. Likewise, “optical switch[] 44” may be used to turn off optical path 88. *Id.*, ¶[0026]. Thus, Shirley’s **detector 70** obtains images of different sides of **object 50**, or from different positions, using **mirrors 26 and 28**.

Fig. 2 of *Shirley* illustrates some of these features.



Shirley, Fig. 2 (annotated)

167. In my opinion, A POSA would have understood from *Shirley* that if **object 50** were a **key**, **detector 70** (e.g., **camera**) of *Shirley* would have obtained an image 88 of an upper surface of **object 50** (e.g., top side of the **key**) directly, without the use of a mirror, by turning off optical paths 84 and 86, using optical switches 40 and 42, respectively. A POSA would have also understood that **detector 70** (e.g.,

camera) of *Shirley* would have obtained an image of a left side (e.g., tip end of a key) of object 50 using a mirror (e.g., mirror 26), by turning off optical paths 86 and 88, using optical switches 42 and 44, respectively.

168. Moreover, a POSA would have understood that the image obtained using mirror 26 would be from a different angle than the image obtained along optical path 88 in the same manner as described by the '385 patent. For example, the '385 patent discloses that different views (or images) of the master key are associated with different angles. Specifically, the '385 patent discloses a “camera angle provides a top view of the blade 18” ('385 patent, 5:8-9) and that its “imaging system may also capture an image of the groove from the end of the tip 14 at an angle parallel to the blade 18” (*id.*, 5:10-12). Like the '385 patent, the detector 70 (e.g., camera) of *Shirley* obtains a different image (e.g., from a different angle) of object 50 using, for example, optical path 88 as compared to an image obtained using optical path 84 via mirror 26.

169. As I also discussed for claim 1[c], a POSA would have been motivated and found it obvious to further modify *Will*'s machine modified by *Cimino* to include one or more mirrors and/or optical switches taught by *Shirley* to obtain images of a master key from different angles without having to relocate the camera, without having to use an additional camera, and/or without having to move the key to obtain the different images. Given the similarities between the machines of *Wills* and

Cimino, and because using mirrors to obtain images as taught by *Shirley* was well known in the art, such a modification would have been within the skill of the POSA and yielded nothing more than predictable results. In my opinion, a POSA thus would have had a reasonable expectation of success in making the modification.

b. 24[c] wherein the image from the second angle is substantially a tip end view; and

170. In my opinion, *Wills* in view of *Cimino* and *Shirley* discloses “the image from the second angle is substantially a tip end view” for the same reasons discussed in claims 1[c] and 24[b].

171. For example, a POSA would recognize that if a master key (e.g., object 50) were to be placed in the optical configuration disclosed by *Shirley* so that a tip of the master key was facing, for example, mirror 26, then the optical path 84 disclosed by *Shirley* would provide substantially a tip end view of the master key from a second angle. And, as described for claim 1[c], a POSA would have found it obvious to modify *Wills*’s machine to obtain a tip end view, as taught by *Cimino*, by implementing mirrors taught by *Shirley* to allow a single camera in *Wills*’s machine to obtain images representing views of a top side and tip end of the master key. As I also discussed there, a POSA would have had a reasonable expectation of success in making the modification.

- c. 24[d] a logic configured to analyze said captured **images** to determine **characteristics** of said **contour** and compare said **characteristics** with **characteristics of known key blanks** to determine the likelihood of a match between said **master key** and a known key blank.

172. In my opinion, *Wills* in view of *Cimino* and *Shirley* teaches “a logic configured to analyze said captured **images** to determine **characteristics** of said **contour** and compare said **characteristics** with **characteristics of known key blanks** to determine the likelihood of a match between said **master key** and a known key blank” for the same reasons discussed in claims 1[b] and 1[c]. For example, as I explained there, *Wills*’s computer subsystem may use one or more of the at least one **image** of the first and/or the second sides to determine the **characteristics** of the **contour** in those images. *Wills*, 15:6-19, 31:44-47, 31:56-61, 32:1-2, 37:11-19. Further, as I explained with respect to claim 1[c], a POSA would have found it obvious to use the **tip end** view (e.g., image of the second side) to determine the **characteristics** of the **contours** on both sides of a **master key**, and/or to confirm the **contour** geometry as determined using the at least one image of the one side of the **master key** as disclosed by *Wills*.

173. In my opinion, POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device

containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely “analyz[ing] said captured images to determine characteristics of said contour and compar[ing]e said characteristics with characteristics of known key blanks to determine the likelihood of a match between said master key and a known key blank.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

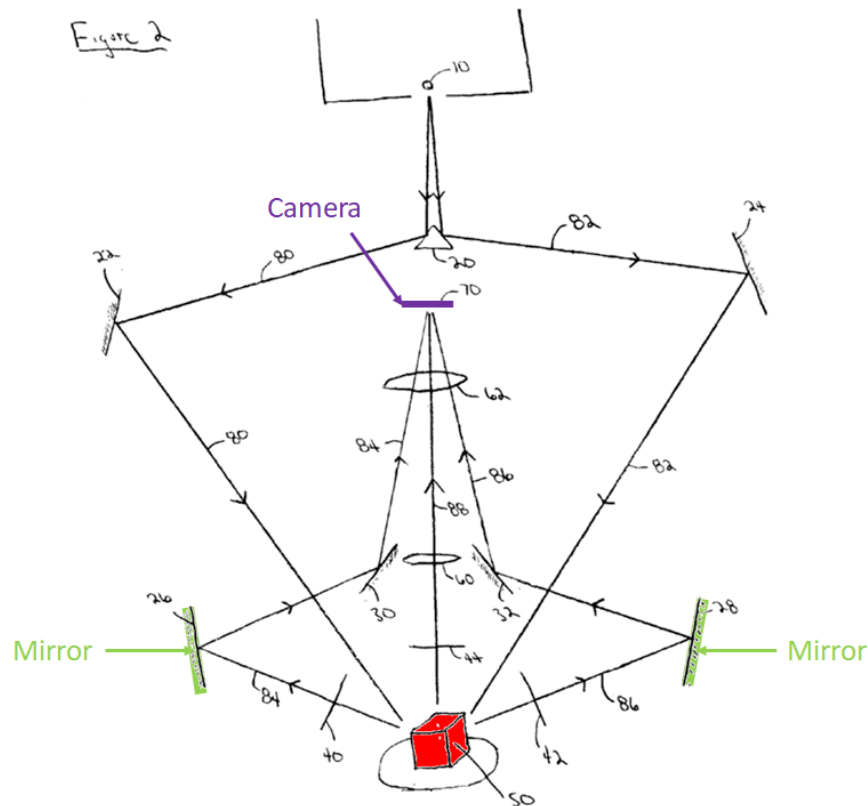
17. Claim 25: The key identification system of claim 24, wherein the at least one mirror is configured to allow the camera to capture one image with multiple views of the master key from different angles.

174. *Wills* in view of *Cimino* and *Shirley* teaches “the at least one mirror is configured to allow the camera to capture one image with multiple views of the master key from different angles.”

175. For example, as I discussed with respect to claim 24[b], *Shirley* discloses capturing images of an object 50 (e.g., master key) along three different optical paths 84, 86, and 88 using mirrors 26, 28, 30, and 32. *Shirley*, ¶¶[0024]-[0026]. In particular, *Shirley*’s mirrors 26 and 28 are configured to reflect the left

side and right side views, respectively, of **object 50** to **detector 70** (e.g., **camera**). *Id.*

For example, as illustrated in Fig. 2 of *Shirley* below, the images obtained along the three optical paths 84, 86, and 88 provide images that are different **views** (e.g., **left side view** along optical path 84, **right side view** along optical path 86, and **top side view** along optical path 88) of object 50.



Shirley, Fig. 2 (annotated)

176. As I explained with respect to claim 24[b], a POSA would have recognized that the images of **object 50** obtained along optical paths 84, 86, and 88 would constitute **views from different angles** in the same manner as described by the '385 patent. '385 patent, 5:8-12. A POSA would also recognize that by turning

on or off each of the optical paths 84, 86, and 88, using optical switches 40, 42, and 44, respectively, **detector 70** would obtain different images of the left, right, and top sides, respectively, of **object 50**. As I described for claim 24[b], *Shirley* discloses the use of optical switches 40, 42, and 44 to turn on or off one or more optical paths. *Shirley*, ¶¶[0025]-[0026]. In my opinion, a POSA would understand that using optical switches 40 and 44 to turn on the optical paths 84 and 88 would allow **detector 70** to obtain a single image including both the first (e.g., left side view) and second view (e.g., top side view) of object 50. Indeed, *Shirley* itself discloses obtaining a single image having different views of object 50. For example, *Shirley* discloses using a lens such that “all three images are in focus on the detector 70 at substantially the same time.” *Id.*, ¶[0025]. Further, *Shirley* discloses that its invention “provides a method and apparatus for combining multiple views of an object.” *Id.*, ¶ [0007]. A POSA would have understood that turning optical paths 84 and 88 on, using optical switches 40 and 44, respectively, would allow **detector 70** to obtain a single **image**, including **the left side and top side views** of **object 50**.

177. In my opinion, a POSA would have recognized that such an image would have provided information regarding contours on both sides of the master key in a single image instead of requiring two separate images of the two sides of the master key. A POSA would have also recognized that obtaining a **tip end** view (e.g., left side view of **object 50**) at the same time as obtaining one or more two-

dimensional slices (e.g., top side view of **object 50**) as taught by *Wills* would have eliminated the need to manually flip the key to obtain an image of any groove on the reverse side of the **key**. As I explained for claim 1[c], doing so would have made the process of identifying a key blank faster. Further, a POSA would have understood that using a single image having views of both sides of the **master key** would have increased the rate of processing the images by reducing the number of image files that must be accessed to obtain the same information. This in turn would have improved the speed of identification of a key blank. A POSA would, therefore, have found it obvious to implement the optical scheme of *Shirley* in *Wills*'s machine to achieve these and other advantages as discussed for claim 1[c]

178. A POSA would have found such a modification obvious because it would have involved nothing more than the use of a known technique—*Shirley*'s mirrors—to improve a similar device—*Wills*'s key regenerating machine—in the same way, namely, by allowing *Wills*'s camera to capture images of different sides of a **master key** using the mirrors taught by *Shirley*. Given the well-known use of mirrors to obtain images of different sides of an object (*see* '984 patent generally), such a modification would have been within the skill of the POSA and yielded nothing more than predictable results. In my opinion, as I explained for claim 1[c], a POSA thus would have had a reasonable expectation of success in making the modification.

18. Claim 26

179. *Wills* in view of *Cimino* and *Shirley* renders obvious claim 26.

a. 26[p] A key identification system comprising:

180. To the extent this preamble is limiting, in my opinion, *Wills* discloses this limitation for the same reasons discussed in claim 1[p].

b. 26[a] an imaging system including a camera configured to capture an image of a master key, the image includes a first view and a second view;

181. In my opinion, *Wills* in view of *Cimino* and *Shirley* teaches this limitation for the same reasons discussed in claim 1[c].

182. For example, *Wills*'s machine employs a "mirror 29," shown in Figure 9, that "reflects the image [of one side the master key] to the camera 28" to be captured. *Wills*, 7:47-48; The image of, for example, an upper side of the master key as illustrated in Fig. 9 is a first view of the master key.

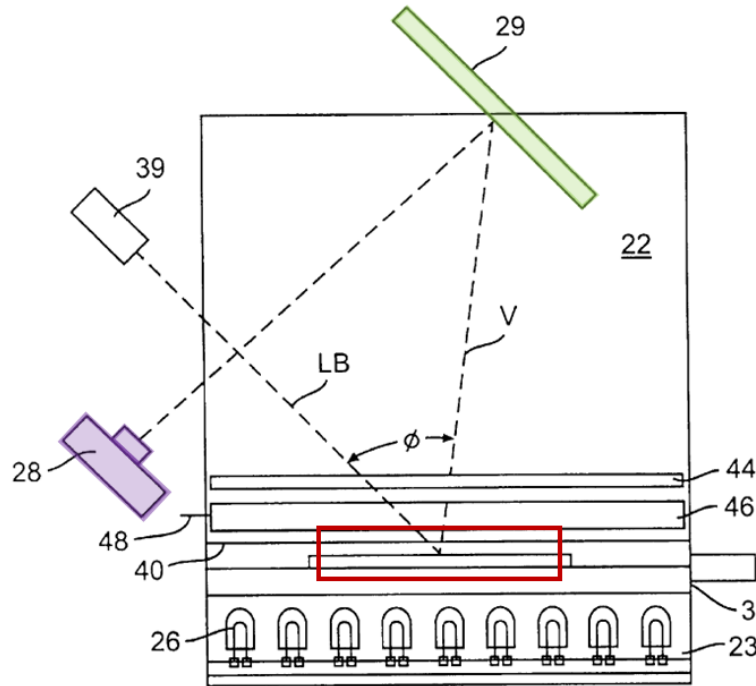


FIG. 9

Wills, Figure 9 (annotated)

183. As also discussed for claims 1[c], a POSA would have been motivated to obtain a tip end view of the master key as taught by *Cimino* to realize the advantages of improved automation, accurate **contour** geometry determination, and/or the ability to confirm the **contour** geometry using the **tip end** view. The **tip end** view is a second view of the **master key**.

- c. **26[b] a first mirror positioned at a first position to allow said camera to capture the first view of the master key**

184. In my opinion, *Wills* discloses this limitation for the same reasons discussed in claim 1[c]. As illustrated in Fig. 9 of *Wills* above, the first mirror (e.g.,

mirror 29) allows camera 28 to capture the first view (e.g., image of a top side) of the master key.

- d. 26[c] at least one second mirror positioned at a second position to allow said camera to capture a second view of the master key, wherein the first view is from a different angle than the second view,

185. In my opinion, *Wills*, *Cimino*, and *Shirley* teach this limitation for the same reasons discussed in claims 1[c] and 24[b].

186. For example, as I discussed there, *Shirley* discloses using a mirror (e.g., mirror 26) to allow the camera (e.g., detector 70) to capture a second view (e.g., tip end view) as taught by *Cimino* from a different angle of object 50 (e.g., master key). *Shirley*, ¶¶[0024]-[0026]. As explained for claim 1[c], in my opinion, a POSA would have found it obvious to implement at least one additional mirror in *Wills*'s machine to be able to obtain an image of the tip end of the master key without the need to relocate *Wills*'s camera, include an additional camera, or move the master key. As also explained there, a POSA would have had a reasonable expectation of success in making the modification.

- e. 26[d] a logic configured to analyze said captured image to determine characteristics of said contour and compare said characteristics with characteristics of known key blanks to determine the likelihood of a match between said master key and a known key blank.

187. In my opinion, *Wills* discloses this limitation for the same reasons

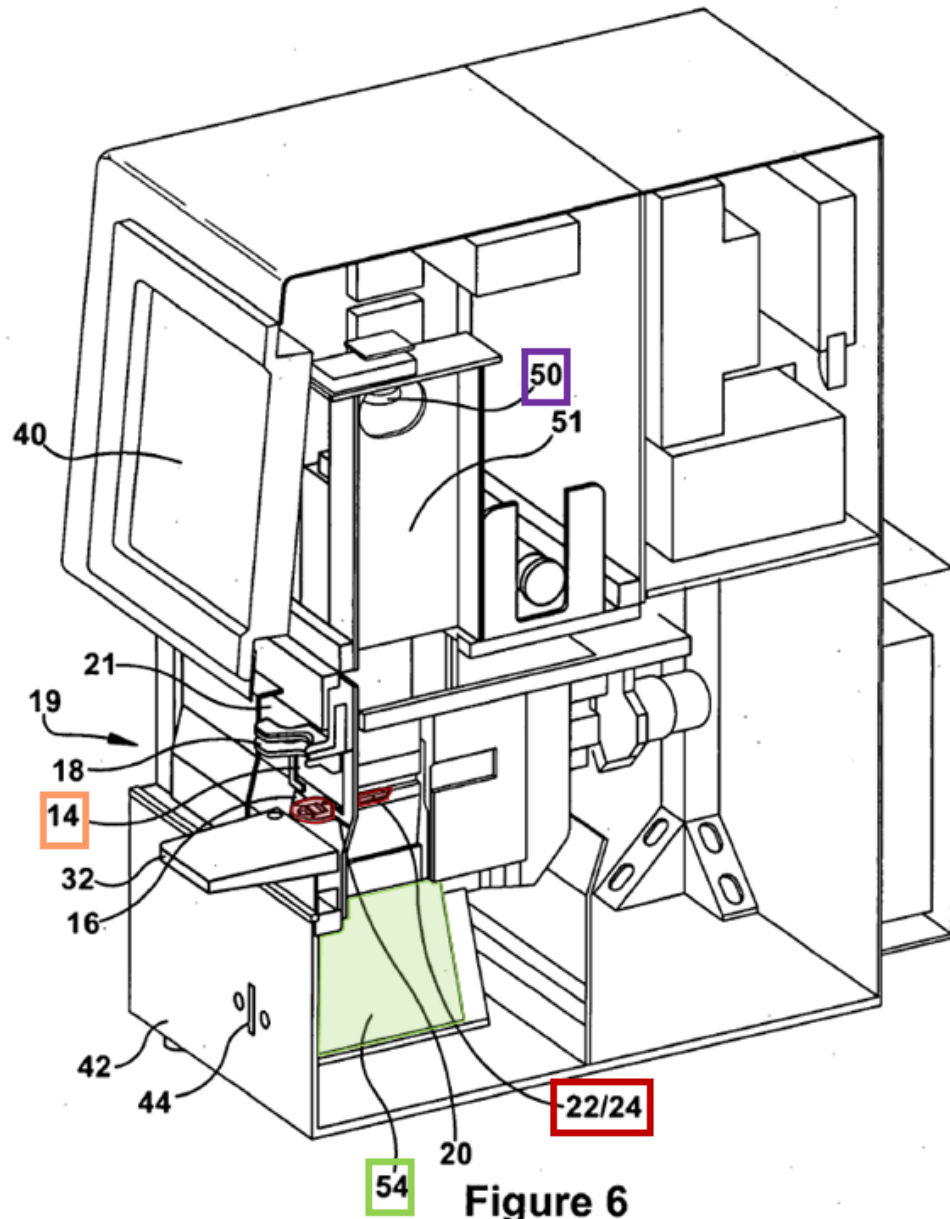
discussed in claims 1[b] and 24[d]. For example, as discussed there, *Wills*'s computer subsystem uses the means for obtaining surface information 2375 to determine the surface information, including the depth from the first and/or second views of the master key. Similarly, *Wills*'s computer subsystem compares the depth measurements for the master key with the depth measurements for the reference keys and, from the comparison, generates a "ranking ... from the most likely match" to the master key among the reference keys "to the least likely match." *Id.*, 15:6-19; *see also id.*, Figures 31 (calculating a "surface score" for the reference keys) and 32 (factoring the "surface score" into the "overall score" and ranking keys by overall score).

188. In my opinion, POSA would have understood *Wills*'s computer subsystem to disclose the claimed "logic," because *Wills*'s computer subsystem is consistent with how the "logic" is described in the '385 patent. For example, the '385 patent provides that the "logic" may take the form of "a memory device containing instructions." '385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using "programs to operate the computer subsystem 16" that "are stored on a hard disk 17," as shown in Figure 5. *Wills*, 6:17-18. In my opinion, "a memory device containing instructions" encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses the function of the logic, namely "analyz[ing] said captured image to

determine **characteristics** of said **contour** and compar[ing] said **characteristics** with **characteristics of known key blanks** to determine the likelihood of a match between said **master key** and a known key blank.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

B. Ground 2: *Wills* in view of *Cimino*, *Shirley*, and *Bass* Would Have Rendered Obvious Claims 6, 17, and 18

189. *Bass*, like *Wills*, describes a machine for duplicating master keys. *Bass*, ¶[0009]. As in *Wills*, the **master key** is placed in the machine, and a **camera** is used to capture an image of the **master key**, as shown in Figure 6. *Id.*, ¶¶[0055]-[0056].



Bass, Figure 6 (annotated).

190. As in *Wills*, where the **master key** is placed into the machine on a “supporting means,” *Wills*, 7:4-8, in *Bass*’s machine in the **master key** is placed into the machine on a “base 16,” as shown. *Bass*, ¶¶[0047], [0050]. In addition, *Bass*’s machine employs a “**door clamp 14**,” as shown. *Id.*

191. *Bass*'s machine, like *Wills*, uses light to illuminate the master key being imaged by the camera. *Wills*, 6:65-7:3; *Bass*, ¶[0057]. *Bass*'s “lighting panel 52” is shown in Figure 7. *Bass*, ¶[0057]. Also, just as *Wills*'s machine employs a mirror, *Wills*, 7:39-50, *Bass*'s system employs a “reflector plate 54,” as shown, *Bass*, ¶[0057].

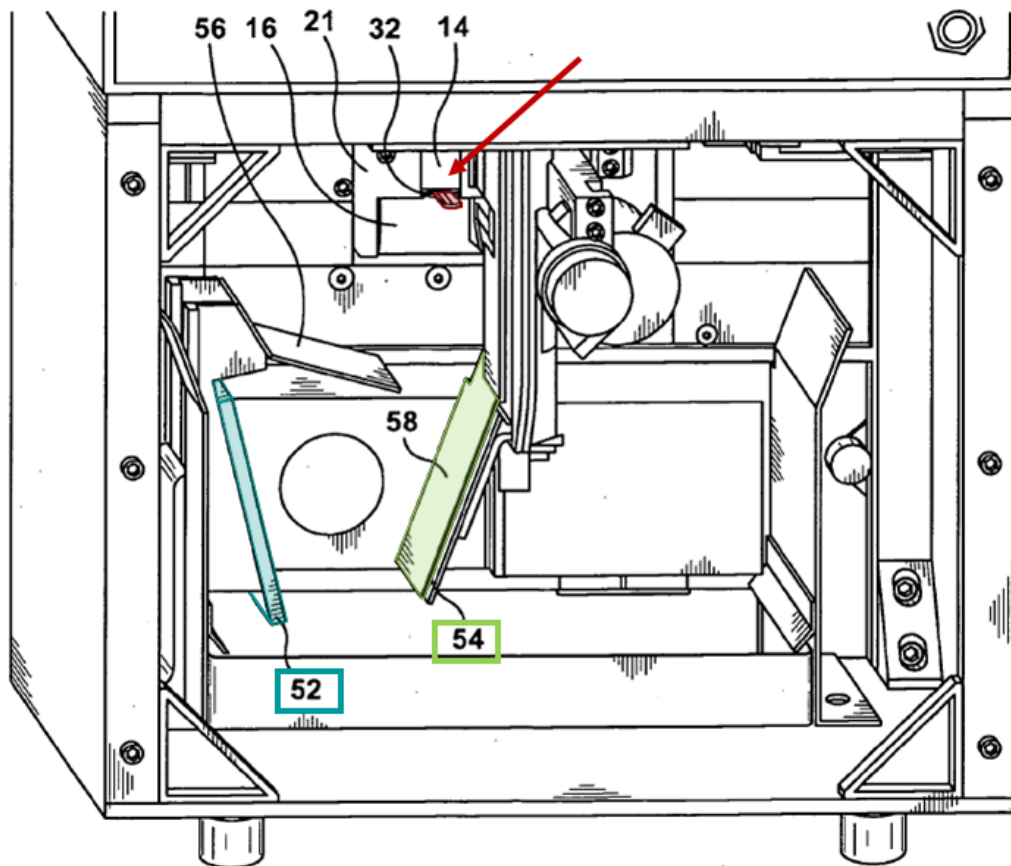


Figure 7

Bass, Figure 7 (annotated).

192. Together, *Wills* and *Bass* or *Wills*, *Cimino*, and *Bass* would have

rendered obvious each of claims 6, 17, and 18, as explained below.

1. **Claim 6: The key identification system of claim 5, wherein said light includes a shield to direct light away from said master key.**

193. *Wills* in view of *Cimino*, *Shirley*, and *Bass* teaches that the “light includes a shield to direct light away from said master key” because *Bass* teaches using a shield to direct light away from a master key to be imaged. In my opinion, from *Bass*, a POSA would have been motivated and found it obvious to modify *Wills*’s machine to include a shield as in *Bass*.

194. As explained for claim 5, *Wills*’s machine for imaging a master key includes an array of LEDs and a mirror, as shown in Figure 9. *Wills*, 6:65-7:3. *Wills*’s machine, modified with an additional mirror as taught by *Shirley*, to obtain a tip end view of the master key as taught by *Cimino* would also include this configuration of LEDs and a mirror because the LEDs would be required to provide illumination and the mirror would be required to direct the illumination on to the master key for the imaging.

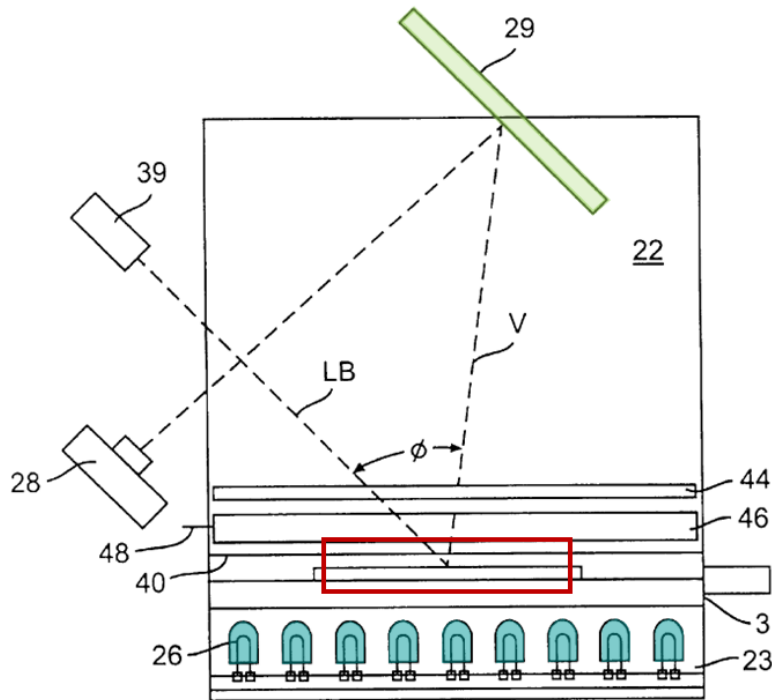


FIG. 9

Wills, Figure 9 (annotated).

195. *Bass*'s machine similarly images the master key using both a "lighting panel 52" and a "reflector plate 54," as shown in Figure 7. *Bass*, ¶[0057]. In addition, *Bass* recommends using a "blocking plate 56." *Id.* As *Bass* explains, the "blocking plate 56" serves "[t]o enhance an image captured by the optical imaging device," because "the positioning of" the reflector plate and the blocking plate can be "adjusted to improve ... captured images." *Id.*, ¶¶[0057], [0059]. A POSA would have understood *Bass*'s blocking plate to be a "shield" because, just as the shield of the '385 patent shields light from the light, *Bass*'s blocking plate blocks light from the lighting panel. Compare '385 patent, 6:46-55 with *Bass*, ¶[0057].

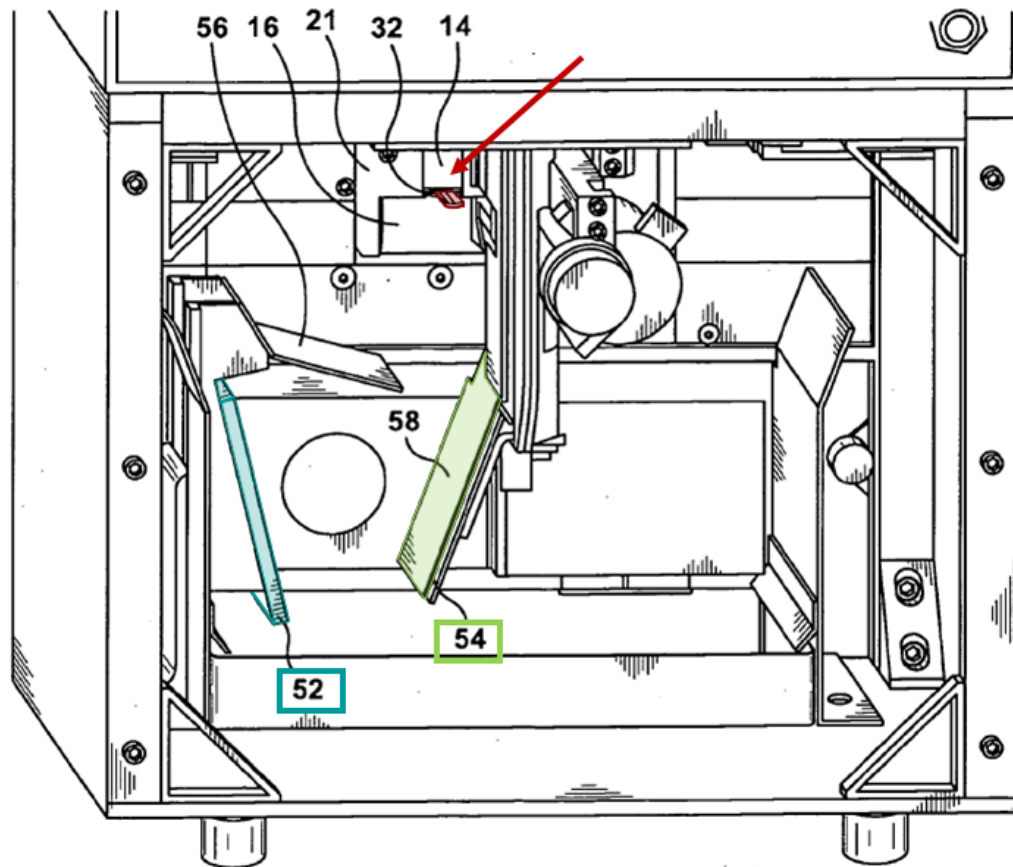


Figure 7

Bass, Figure 7 (annotated).

196. In my opinion, from *Bass*, a POSA would have been motivated and found it obvious to further modify *Wills*'s machine, as modified by *Cimino* and *Shirley*, to similarly include a blocking plate for use with *Wills*'s LEDs and mirror, in the same manner that *Bass*'s blocking plate is used with *Bass*'s lighting panel and reflector plate. A POSA would have been motivated by *Bass*'s teaching that such a blocking plate, together with a reflector plate like *Wills*'s mirror, serves "[t]o

enhance an image captured by [an] optical imaging device,” like *Wills’s* camera, because “the positioning of” the **mirror** and the blocking plate can be “adjusted to improve ... captured images.” *Bass*, ¶¶[0057], [0059]. As one example, a POSA would have recognized that many keys are made of, finished with, and/or painted using a reflective material, such that glare is possible. Because glare can obscure the captured image, especially details of the contour of the master key visible in the image, a POSA would be motivated to adjust the positioning of the **mirror** and the blocking plate to minimize glare. A POSA would have found such a modification obvious because it would have involved nothing more than the use of a known technique—*Bass’s* blocking plate in a key duplicating machine—to improve a similar device—*Wills’s* key regenerating machine as modified by *Cimino* and *Shirley*—in the same way, namely, by serving to enhance an image of a **master key** captured by a camera. In my opinion, given the similarities between *Wills’s* machine as modified by *Cimino* and *Shirley* and *Bass’s* machine, such a modification would have been within the skill of the POSA and yielded nothing more than predictable results. In my opinion, therefore, a POSA would have had a reasonable expectation of success in making the modification.

197. In my opinion, a POSA would have recognized that it would be possible to include a shield as taught by *Bass* in *Wills’s* machine as modified by *Cimino* and *Shirley*. For example, the combination of *Wills* and *Cimino* allows *Wills’s* machine

to additionally obtain a tip end view and use that additional view to determine the geometry of the milling in the master key, or to confirm that a correct key blank has been identified. Further, the combination of *Shirley* with *Wills*'s machine as modified by *Cimino* provides one or more mirrors to allow the thus modified *Wills* machine to obtain the tip end view of the master key. In my opinion, addition of one or more mirrors taught by *Shirley* to *Wills*'s machine would not have prevented further addition of a shield as taught by *Bass*. In my own work at Hillman, I designed machines that used mirrors to allow for imaging of different portions of a master key and further used shields to control the amount of light being used to illuminate the master key for imaging. In my opinion, a POSA would have been motivated to include the shield as disclosed by *Bass* in *Wills*'s machine as modified by *Cimino* and *Shirley* to achieve the same advantages I discussed above with respect to modifying *Wills*'s machine with *Bass*.

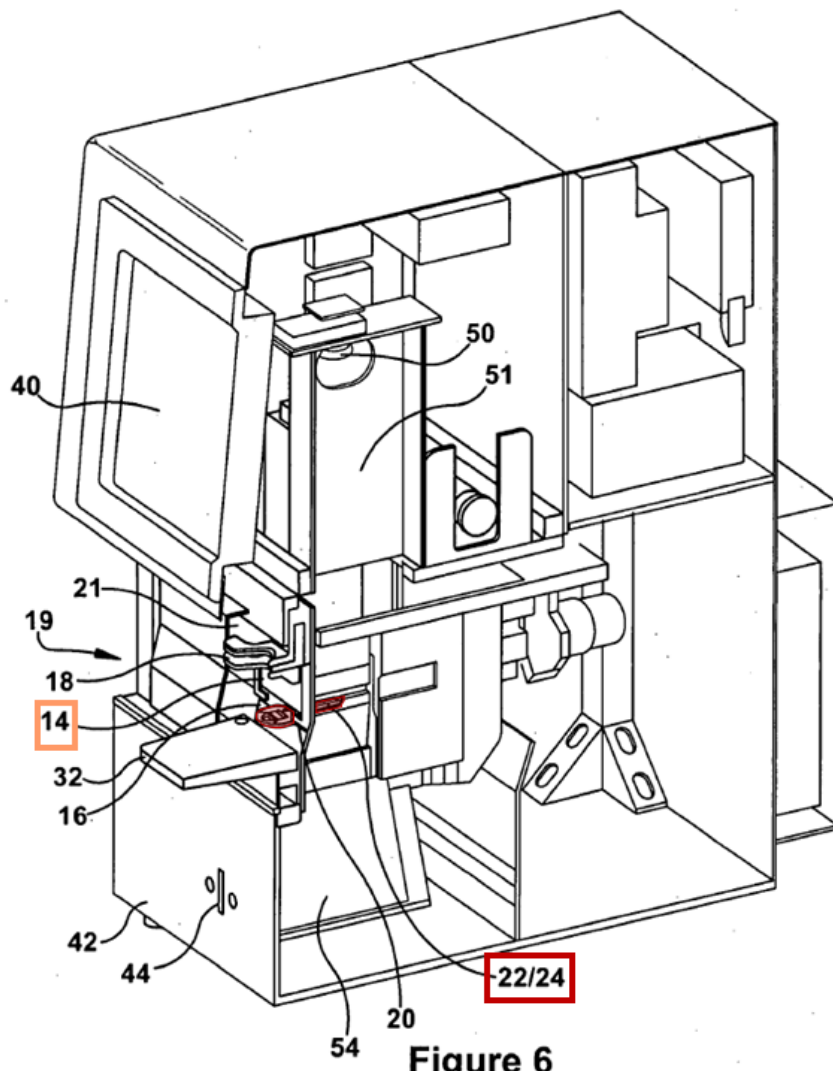
2. Claim 17: The key identification system of claim 15, wherein said key holder includes an upper door.

198. *Wills* in view of *Cimino*, *Shirley*, and *Bass* teaches that the “key holder includes an upper door” because *Bass* teaches supporting the master key using a door clamp, and, from *Bass*, a POSA would have been motivated and found it obvious to modify the supporting means of *Wills*'s machine to include a door clamp as in *Bass*.

199. In *Wills*, the master key is placed into the machine on a “supporting means,” which in some embodiments includes “clear protrusions” or “a cut-out

template ... into which the master key is placed.” *Wills*, 7:4-20. *Wills*’s machine, modified with an additional mirror as taught by *Shirley*, to obtain a tip end view of the master key as taught by *Cimino* would also include the supporting means to support the master key during the imaging process.

200. Similarly, in *Bass*’s machine, the master key is placed into the machine on a “base 16,” as shown in Figure 6. *Bass*, ¶¶[0047], [0050]. In addition, as shown, *Bass*’s machine employs a “door clamp 14.” *Id.*



Bass, Figure 6 (annotated).

201. *Bass's door clamp* 14 and base 16 are further illustrated in Figure 5, below.

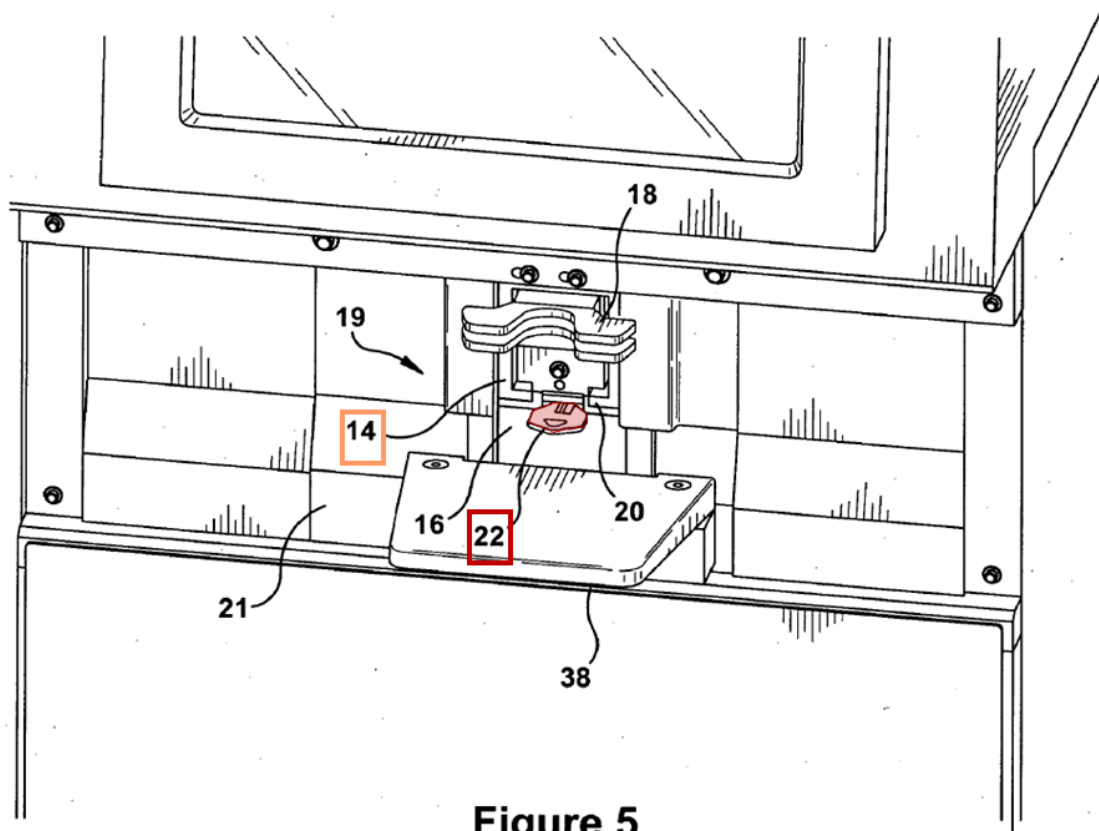


Figure 5

Bass, Figure 5 (annotated).

202. A POSA would have understood *Bass*’s **door clamp** to be an “upper door.” Like the “**upper door**” of the ’385 patent, which together with a “lower support” serves to “close onto the **key**,” ’385 patent, 4:1-3, *Bass* teaches that the **door clamp**, together with the base, “secure[s] [the] **master key**” by applying a “force ... sufficient to retain or hold the **key** ... in place.” *Bass*, ¶[0047].

203. In my opinion, from *Bass*, a POSA would have been motivated and found it obvious to further modify *Wills*'s machine, as modified by *Cimino* and *Shirley*, to include a door clamp as in *Bass*, to the extent this is not disclosed in *Wills*. A POSA would have been motivated by *Bass*'s teaching that the door clamp, together with a base like the bottom of the drawer in *Wills*, “secure[s] [the] master key” by applying a “force ... sufficient to retain or hold the key ... in place.” *Bass*, ¶[0047]. A POSA would have recognized that *Bass*'s door clamp, when implemented in *Wills*'s machine as modified by *Cimino* and *Shirley*, would have improved the ability of *Wills*'s machine to hold the master key in place, thereby improving the accuracy of the captured image as well as the ultimate duplication of the master key.

204. For example, *Wills* teaches that the drawer in *Wills*'s machine must be closed by an operator after the master key has been placed in it, *Wills*, 7:54-56, which a POSA would have recognized poses a risk that the master key will shift out of place during the closing. A POSA would have recognized that “secur[ing] [the] master key” with a door clamp, as *Bass* recommends, would aid in addressing this risk. A POSA would have found such a modification obvious because it would have involved nothing more than the use of a known technique—*Bass*'s door clamp in a key duplicating machine—to improve a similar device—*Wills*'s key regenerating machine as modified by *Cimino* and *Shirley*—in the same way, namely, by securing

the master key by applying a force sufficient to retain or hold the key in place on a support below. In my opinion, it would have been within a POSA's skill to implement a door clamp, as *Bass* recommends, that effectively secured the master key in *Wills's* drawer without hampering operation of *Wills's* machine as modified by *Cimino* and *Shirley*.

205. As one example, as noted in Section II, the machines I designed and implemented while I was employed at Hillman included both machines in which the master key was laid upon a surface and machines in which the master key was secured using a clamp. Based on my experience, it would have been within the skill of a POSA to implement a door clamp, as *Bass* recommends, that effectively secured the master key in *Wills's* drawer without hampering operation of *Wills's* machine. To this end, a POSA would have taken into account possible variations in the master key, such as those resulting from manufacture and/or those resulting from wear and tear, as well as which aspects of the master key must remain visible to the camera in order for *Wills's* machine to operate as intended. These considerations are relevant in many aspects of the design of key duplication machines, and a POSA would have readily been able to recognize and address these considerations. In general, given the similarities between *Wills's* machine as modified by *Cimino* and *Shirley* and *Bass's* machine, such a modification would have been within the skill of the POSA and yielded nothing more than predictable results. In my opinion, therefore, a POSA

would have had a reasonable expectation of success in making the modification.

206. In my opinion, a POSA would have recognized that it would be possible to include a door clamp as taught by *Bass* in *Wills*'s machine as modified by *Cimino* and *Shirley*. For example, the combination of *Wills* and *Cimino* allows *Wills*'s machine to additionally obtain a tip end view and use that additional view to determine the geometry of the milling in the master key, or to confirm that a correct key blank has been identified. Further, the combination of *Shirley* with *Wills*'s machine as modified by *Cimino* provides one or more mirrors to allow the thus modified *Wills* machine to obtain the tip end view of the master key. In my opinion, addition of one or more mirrors taught by *Shirley* to *Wills*'s machine would not have prevented further addition of a door clamp as taught by *Bass* to hold the master key for imaging. In my own work at Hillman, I designed machines that used mirrors to allow for imaging of different portions of a master key and further used clamps such as a door clamp to hold the master key in position for imaging. In my opinion, a POSA would have been motivated to include the door clamp as disclosed by *Bass* in *Wills*'s machine as modified by *Cimino* and *Shirley* to achieve the same advantages I discussed above with respect to modifying *Wills*'s machine with *Bass*.

3. Claim 18: The key identification system of claim 17, wherein said key holder includes a clamp.

207. As explained for claim 17, a POSA would have been motivated and found it obvious to modify *Wills*'s machine, as modified by *Cimino* and *Shirley*, to

include a **door clamp**, as in *Bass*, to the extent this is not disclosed in *Wills*. A POSA would have understood the **door clamp** to be a “clamp.” This is because, like the “**clamp**” of the ’385 patent, which is merely an alternative to the “upper door” and similarly serves together with a “lower support” to “close onto the **key**,” ’385 patent, 4:1-6, *Bass* teaches that the **door clamp**, together with the base, provides additional functionality to “secure [the] **master key**” by applying a “force ... sufficient to retain or hold the **key** ... in place.” *Bass*, ¶[0047].

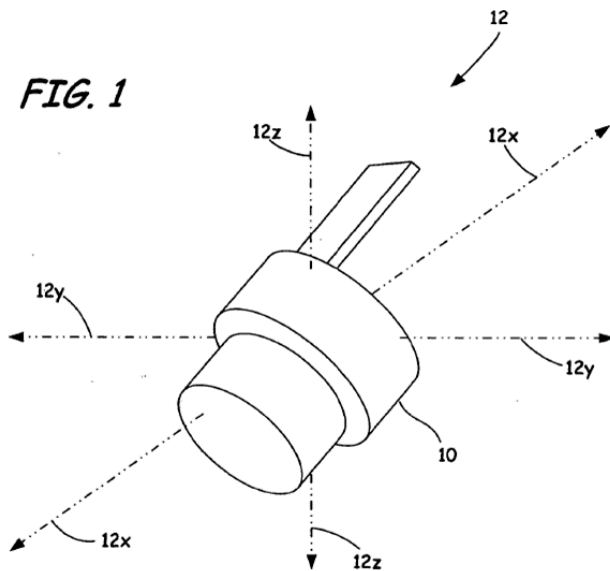
208. In my opinion, a POSA would have recognized that it would be possible to include a door clamp as taught by *Bass* in *Wills*’s machine as modified by *Cimino* and *Shirley* for substantially the same reasons as I described for claim 17. In my opinion, a POSA would have been motivated to include the door clamp as disclosed by *Bass* in *Wills*’s machine as modified by *Cimino* to achieve the same advantages I discussed above with respect to modifying *Wills*’s machine with *Bass*. In general, given the similarities between *Wills*’s machine as modified by *Cimino* and *Shirley* and *Bass*’s machine, such a modification would have been within the skill of the POSA and yielded nothing more than predictable results. In my opinion, therefore, a POSA would have had a reasonable expectation of success in making the modification.

C. Ground 3: *Wills* in view of *Cimino*, *Shirley*, and *Heide* Would Have Rendered Obvious Claims 9 and 11

209. *Heide* describes a “three-dimensional object” akin to the “three-

dimensional surface image” captured by *Wills*’s machine. *Heide*, Abstract; *Wills*, 15:34-42. And just as *Wills* envisions “convert[ing]” its three-dimensional image “by ... rotating to a predetermined reference position and orientation,” *Wills*, 9:35-38, *Heide* teaches “rotat[ing]” its three-dimensional image “relative to one or more ... axes” to arrive at an “optimal spatial orientation,” *Heide*, ¶¶[0037]-[0038].

210. A POSA would have recognized that rotation about the “axes” described in *Heide* corresponds to the “rolling” and “tipping” described in the ’385 patent, as a comparison of *Heide*’s Figure 1 and Figure 14 of the ’385 patent shows. In particular, a POSA would have understood rotation about *Heide*’s axis “12x” to correspond to the “rolling” of the ’385 patent. Similarly, a POSA would have understood rotation about *Heide*’s axes “12y” and/or “12z” to correspond to the “tipping” of the ’385 patent.



Heide, Figure 1

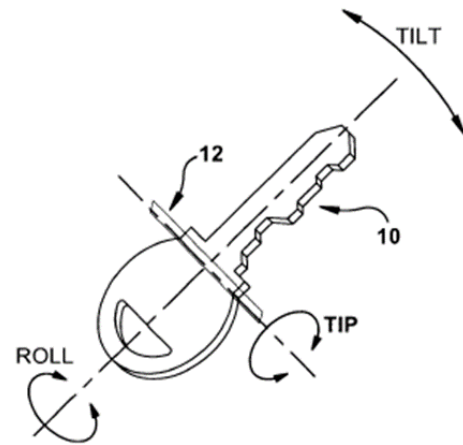


FIG. 14

'448 Patent, Figure 14

211. Together, *Wills*, *Cimino*, *Shirley*, and *Heide* would have rendered obvious each of claims 9 and 11, as explained below.

1. **Claim 9: The key identification system of claim 1, wherein said logic accounts for rolling of said master key with respect to said imaging system to determine characteristics of said contour.**

212. *Wills* in view of *Cimino*, *Shirley*, and *Heide* teaches “account[ing] for rolling of said master key with respect to said imaging system to determine characteristics of said contour” because *Wills*’s machine accounts for variations in the position of the master key with respect to the camera in extracting the depth measurements of the surface information. *Wills* and *Heide* would have rendered obvious “rolling of said master key with respect to said imaging system” because *Wills* envisions accounting for rolling of the master key with respect to the camera

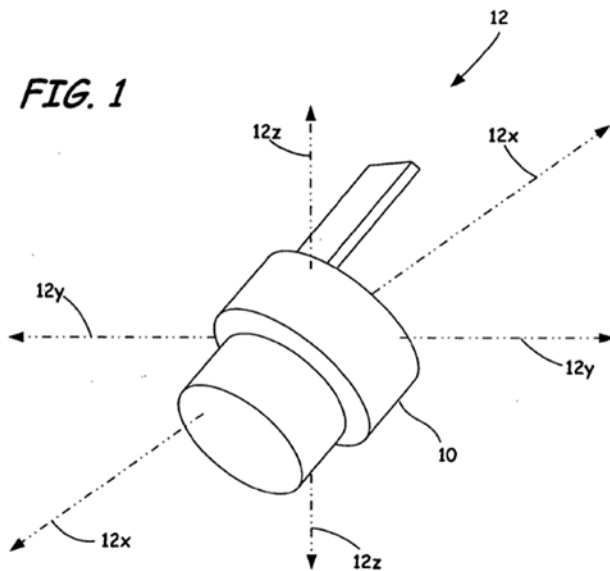
in extracting the **depth measurements** of the **surface information** by “rotating” the three-dimensional image captured by its **camera** “to a predetermined reference position and orientation.” *Wills*, 9:35-38. *Heide* teaches rotating a three-dimensional object to an optimal spatial orientation by rotating the three-dimensional object about any of the three axes. *Heide*, ¶¶[0037]-[0038]. In my opinion, from *Heide*, a POSA would have been motivated and found it obvious to implement *Wills*’s “rotating to a predetermined reference position and orientation” to be rotating along any of the three axes, including that called “rolling” in the ’385 patent.

213. *Wills* envisions accounting for rolling of the **master key** with respect to the **camera** in extracting the **depth measurements** of the **surface information** by “rotating” the three-dimensional image captured by its **camera** “to a predetermined reference position and orientation.” *Wills*, 9:35-38. A POSA would have recognized that a key in *Wills*’s machine, as modified by *Cimino* and *Shirley*, may deviate from a “predetermined reference position and orientation” and require “rotating” for several reasons, including, for example, deformation of the **master key** that commonly results from use, such as bending or chipping, or aspects of the **master key**’s design, such as a rubberized head that prevents the key from lying flat. *See, e.g., Wills*, 1:35-37 (recognizing that keys may deviate “[from] factory specifications” once “worn from use”). As explained in Section II, in my own work at Hillman I designed machines to work with numerous types of keys and to account for

variations in keys made by different manufacturers as well as the variations in keys that result from wear and tear, such as bending, warping, breakage, and/or alteration in the blade and/or milling that results from use. In my work, I designed key duplication machines to address these variations by recognizing how the key duplication machines would need to account for them. A POSA would have recognized the need to do the same in *Wills*'s machine.

214. Indeed, as *Wills* explains, such “rotating” allows the “key information” of the master key, including the extracted depth measurements, to be “standardized” so as “to be comparable to” the information about the reference keys. *Wills*, 9:38-43. As a result, *Wills*'s machine, modified by *Cimino* and *Shirley*, would also “not require the master key to be precisely aligned to operate efficiently.” *Wills*, 7:29-31. This is akin to the stated purpose of the “rolling” in the '385 patent, namely, so that “[t]he key . . . is not constrained to a particular orientation or position.” '385 patent, 7:17-18.

215. While *Wills* thus describes “rotating” the three-dimensional image, *Wills* does not expressly teach along which axes the “rotating” occurs. *Heide* teaches rotating a three-dimensional object, like the three-dimensional image in *Wills*, to an optimal spatial orientation by rotating the three-dimensional object about any of the three axes. *Heide*, ¶¶[0037]-[0038].



Heide, Figure 1

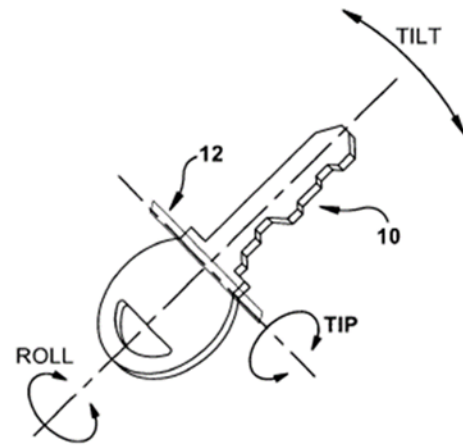


FIG. 14

'385 Patent, Figure 14

216. A POSA would have recognized that rotation about the “12x” axis described in *Heide* corresponds to the “rolling” described in the '385 patent, as a comparison of *Heide*’s Figure 1 and Figure 14 of the '385 patent shows. Such rotation about the “12x” axis of the three-dimensional object is consistent with one way that “rolling” is described in the '385 patent, namely, “rotat[ing]” the **master key** “around the axis of the **key**” itself. '385 patent, 7:22-23.

217. In my opinion, from *Heide*, a POSA would have been motivated and found it obvious to implement *Wills*’s “rotating to a predetermined reference position and orientation” to include rotating along any of the three axes, including that called “rolling” in the '385 patent. A POSA would have been motivated by *Wills*’s stated intent to “rotat[e]” the three-dimensional image captured by its **camera**

“to a predetermined reference position and orientation” so that *Wills*’s machine “does not require the master key to be precisely aligned to operate efficiently.” *Wills*, 7:29-31, 9:35-38. A POSA would have been further motivated by *Heide*’s teaching that rotating a three-dimensional object along all three axes facilitates achieving an “optimal spatial orientation” of the three-dimensional object. *Heide*, ¶¶[0037]-[0038]. In my opinion, therefore, a POSA would have found it obvious because implementing such rotation in *Wills*’s machine, as modified by *Cimino* and *Shirley*, would have involved nothing more than the use of a known technique—*Heide*’s rotation of a three-dimensional object along the 12x axis—to improve a similar context—*Wills*’s rotation of a three-dimensional image—in the same way, namely, by facilitating conversion of the three-dimensional image to an “optimal spatial orientation.” A POSA would have recognized that accounting for “rolling” as recited in the ’385 patent, was known to facilitate comparison of the image of the master key and images of the reference keys, as *Wills* describes, especially in a machine like *Wills*’s where the master key, placed in a drawer, *Wills*, 7:4-8; 11:44-46, can be “rolled” due to variations in the master key. In my own work at Hillman, such variations in master keys were recognized and addressed in machines in which the master key was laid upon a surface like *Wills*’s drawer. Given *Wills*’s already discloses rotating its three-dimensional image, such a modification would have been within the skill of the POSA and yielded nothing more than predictable results. In

my opinion, therefore, a POSA would have had a reasonable expectation of success in making the modification.

218. Additionally, in my opinion, a POSA would have recognized that it would be possible to implement the rotations about the “12x” axis as disclosed by *Heide* in *Wills*’s machine as modified by *Cimino* and *Shirley*. In my opinion, addition of one or more mirrors taught by *Shirley* to *Wills*’s machine to obtain the tip end view taught by *Cimino* would not have prevented further addition of rotation about the 12x axis as taught by *Heide*. A POSA would have been motivated to include the rotations as disclosed by *Heide* in *Wills*’s machine as modified by *Cimino* and *Shirley* to achieve the same advantages I discussed above with respect to modifying *Wills*’s machine with *Heide*.

219. In my opinion, POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above,

Wills discloses that its computer subsystem discloses the function of the logic, namely “account[ing] for rolling of said **master key** with respect to said imaging system to determine **characteristics** of said **contour**.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

2. Claim 11: The key identification system of claim 1, wherein said logic accounts for tipping of said **master key with respect to said imaging system to determine **characteristics** of said **contour**.**

220. *Wills* in view of *Cimino*, *Shirley*, and *Heide* discloses “account[ing] for positional variations of said **master key** with respect to said imaging system to determine **characteristics** of said **contour**” because *Wills*’s machine accounts for variations in the position of the **master key** with respect to the **camera** in extracting the **depth measurements** of the **surface information**. *Wills* and *Heide* would have rendered obvious “tipping of said **master key** with respect to said imaging system” because *Wills* envisions accounting for variations of the **master key** with respect to the **camera** in extracting the **depth measurements** of the **surface information** by “rotating” the three-dimensional image captured by its **camera** “to a predetermined reference position and orientation,” *Wills*, 9:35-38. *Heide* teaches rotating a three-dimensional object to an optimal spatial orientation by rotating the three-dimensional object about any of the three axes, *Heide*, ¶¶[0037]-[0038]. In my opinion, from *Heide*, a POSA would have been motivated and found it obvious to

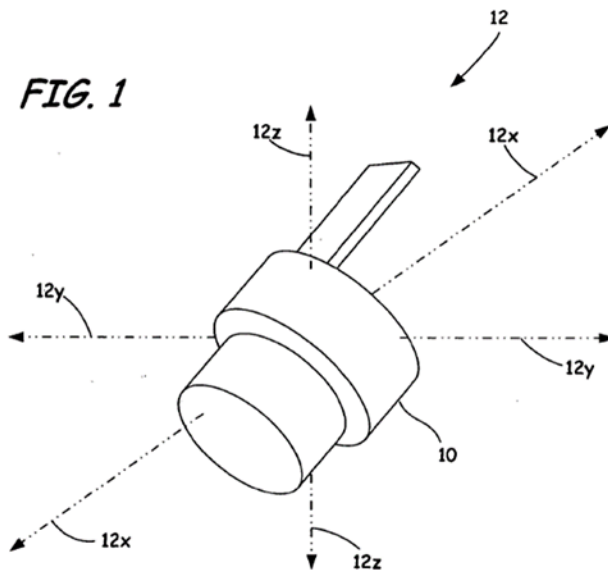
implement *Wills*'s "rotating to a predetermined reference position and orientation" to be rotating along any of the three axes, including that called "tipping" in the '385 patent.

221. *Wills* envisions tipping of the master key with respect to the camera in extracting the depth measurements of the surface information by "rotating" the three-dimensional image captured by its camera "to a predetermined reference position and orientation." *Wills*, 9:35-38. A POSA would have recognized that a key in *Wills*'s machine, as modified by *Cimino* and *Shirley*, may deviate from a "predetermined reference position and orientation" and require "rotating" for several reasons, including, for example, deformation of the master key that commonly results from use, such as bending or chipping, or aspects of the master key's design, such as a rubberized head that prevents the key from lying flat. *Wills*, 1:35-37 (recognizing that keys may deviate "from factory specifications" once "worn from use"). As explained in Section II, in my own work at Hillman I designed machines to work with numerous types of keys and to account for variations in keys made by different manufacturers as well as the variations in keys that result from wear and tear, such as bending, warping, breakage, and/or alteration in the blade and/or milling that results from use. In my work, I designed key duplication machines to address these variations by recognizing how the key duplication machines would need to account for them. A POSA would have recognized the need to do the same

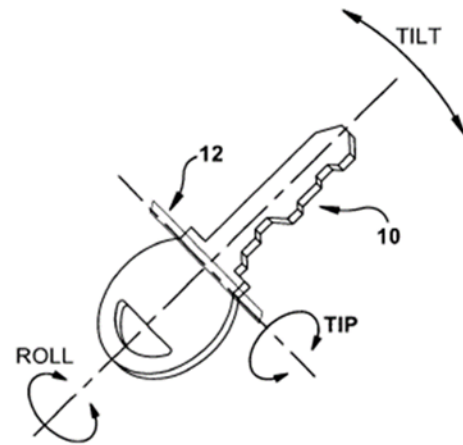
in *Wills*'s machine, as modified by *Cimino* and *Shirley*.

222. Indeed, as *Wills* explains, such “rotating” allows the “key information” of the **master key**, including the extracted **depth measurements**, to be “standardized” so as “to be comparable to” the information about the reference keys. *Wills*, 9:38-43. As a result, *Wills*'s machine “does not require the **master key** to be precisely aligned to operate efficiently.” *Wills*, 7:29-31. This is akin to the stated purpose of the “tipping” in the '385 patent, namely, so that “[t]he **key** . . . is not constrained to a particular orientation or position.” '385 patent, 7:17-18.

223. While *Wills* thus describes “rotating” the three-dimensional image, *Wills* does not expressly teach along which axes the “rotating” occurs. *Heide* teaches rotating a three-dimensional object, like the three-dimensional image in *Wills*, to an optimal spatial orientation by rotating the three-dimensional object about any of the three axes. *Heide*, ¶¶[0037]-[0038].



Heide, Figure 1



'385 Patent, Figure 14

224. A POSA would have recognized that rotation about the “12y” or “12z” axis described in *Heide* corresponds to the “tipping” described in the '385 patent, as a comparison of *Heide*’s Figure 1 and Figure 14 of the '385 patent shows. Such rotation about the “12y” or “12z” axis of the three-dimensional object is consistent with one way that “tipping” is described in the '385 patent, namely, “tipped up or down relative to the plane defined perpendicular to the door opening 12.” '385 patent, 7:21-22.

225. In my opinion, from *Heide*, a POSA would have been motivated and found it obvious to implement *Wills*’s “rotating to a predetermined reference position and orientation” to include rotating along any of the three axes, including that called “tipping” in the '385 patent. A POSA would have been motivated by

Wills's stated intent to "rotat[e]" the three-dimensional image captured by its camera "to a predetermined reference position and orientation" so that *Wills*'s machine "does not require the master key to be precisely aligned to operate efficiently." *Wills*, 7:29-31, 9:35-38. A POSA would have been further motivated by *Heide*'s teaching that rotating a three-dimensional object along all three axes facilitates achieving an "optimal spatial orientation" of the three-dimensional object. *Heide*, ¶¶[0037]-[0038]. A POSA would have found it obvious because implementing such rotation in *Wills*'s machine, as modified by *Cimino* and *Shirley*, would have involved nothing more than the use of a known technique —*Heide*'s rotation of a three-dimensional object along the "12y" or "12z" axes—to improve a similar context—*Wills*'s rotation of a three-dimensional image—in the same way, namely, by facilitating conversion of the three-dimensional image to an "optimal spatial orientation." A POSA would have recognized that accounting for "tipping" of the '385 patent, was known to facilitate comparison of the image of the master key and images of the reference keys, as *Wills* describes, especially in a machine like *Wills*'s where the master key, placed in a drawer, *Wills*, 7:4-8; 11:44-46, can be "tipped" by variations in the master key. In my own work at Hillman, such positional variations were recognized and addressed in machines in which the master key was laid upon a surface like *Wills*'s drawer. Given *Wills*'s already discloses rotating its three-dimensional image, such a modification would have been within the skill of the

POSA and yielded nothing more than predictable results. In my opinion, therefore, a POSA would have had a reasonable expectation of success in making the modification.

226. Additionally, in my opinion, a POSA would have recognized that it would be possible to implementing the rotations about the “12y” and “12z” axes as disclosed by *Heide* in *Wills*’s machine as modified by *Cimino* and *Shirley*. In my opinion, addition of one or more mirrors taught by *Shirley* to *Wills*’s machine to obtain the tip end view taught by *Cimino* would not have prevented further addition of rotation about the “12y” and “12z” axes as taught by *Heide*. A POSA would have been motivated to include the rotations as disclosed by *Heide* in *Wills*’s machine as modified by *Cimino* and *Shirley* to achieve the same advantages I discussed above with respect to modifying *Wills*’s machine with *Heide*.

227. In my opinion, POSA would have understood *Wills*’s computer subsystem to disclose the claimed “logic,” because *Wills*’s computer subsystem is consistent with how the “logic” is described in the ’385 patent. For example, the ’385 patent provides that the “logic” may take the form of “a memory device containing instructions.” ’385 patent, 4:22-37. Similarly, *Wills* describes implementing its computer subsystem using “programs to operate the computer subsystem 16” that “are stored on a hard disk 17,” as shown in Figure 5. *Wills*, 6:17-18. In my opinion, “a memory device containing instructions” encompasses

programs stored on a hard disk, as *Wills* describes. Moreover, as discussed above, *Wills* discloses that its computer subsystem discloses the function of the logic, namely “account[ing] for tipping of said **master key** with respect to said imaging system to determine **characteristics** of said **contour**.” For this reason, my opinion that *Wills* discloses the claimed “logic” is the same whether or not “logic” is construed as a means-plus-function term. *See* Section VIII.

X. CONCLUSION

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

Dated: 10-24-22

By: Scott Basham
Scott Basham
Chandler, Arizona