UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NEARMAP US, INC.,
Petitioner

v.

PICTOMETRY INTERNATIONAL CORP.,
Patent Owner

Case IPR2024-00729
Patent 9,182,657

EXPERT DECLARATION OF DAVID A. FORSYTH, D.PHIL., IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,182,657

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I, David A. Forsyth, D.Phil., hereby declare under penalty of perjury:

I. INTRODUCTION

1. I have been retained by Groombridge, Wu, Baughman & Stone LLP, on behalf of Nearmap US, Inc. ("Nearmap") to provide assistance regarding U.S. Patent No. 9,182,657 ("the '657 patent"). Specifically, I have been asked to consider the validity of claims 1-5, 14, 19-21, 26, and 27 of the '657 patent (the "Challenged Claims"). Except as otherwise indicated, 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 a rate of $450 per hour. I will be reimbursed for the expenses that I incur in 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 litigations involving Eagle View Technologies, Inc. and Pictometry International, Corp. (together, "Pictometry" or "Patent Owner") or Nearmap US, Inc., Nearmap Australia Pty Ltd, and Nearmap Pty Ltd.

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II. BACKGROUND AND QUALIFICATIONS

3. I offer statements and opinions on behalf of Nearmap, generally regarding the validity, novelty, prior art, obviousness considerations, and understanding of a person of ordinary skill in the art as it relates to the '657 patent.

4. Much of my educational training as well as my decades of contributions to the field of computer vision as well as teaching computer science and electrical engineering—specifically autonomous vehicle system engineering and computer vision—are relevant to the subjects of this declaration.

5. In 1984, I earned a Bachelor of Science in Electrical Engineering at the University of the Witwatersrand. In 1986, I earned a Master of Science in Electrical Engineering at the University of Witwatersrand. And in 1989, I earned a Master of Arts and a Doctor of Philosophy from Oxford University.

6. After receiving my Doctor of Philosophy, I stayed at Oxford as a post-doctoral fellow before becoming a professor at the University of Iowa in 1991, where I taught computer science. In 1994, I began teaching as a professor of computer science and electrical engineering at the University of California, Berkley, where I taught for ten years before becoming a professor at the University of Illinois Urbana-Champaign in August 2004. As a professor, some of my recent courses have included autonomous vehicle system engineering and computer vision. For example, I taught Autonomous Vehicle System Engineering in Fall 2022 and Spring

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2023; Computer Vision in Fall 2023; and Optimization for computer vision and machine learning in Spring 2024. Since 2014, I have served as the Fulton Watson Copp Chair in Computer Science at the University of Illinois.

7. In my contributions as a researcher in the field, I have published over 130 papers on computer vision, computer graphics, and machine learning. I have authored or co-authored eight books on topics such as computer vision, including "Computer Vision: A Modern Approach," which has been published in two editions (the first in 2002, and the second in 2011) and has been widely adopted as a course text at institutions such as Massachusetts Institute of Technology, University of Wisconsin-Madison, University of Illinois Urbana-Champaign, Georgia Institute of Technology, and University of California, Berkley. I am a listed inventor on four patents covering various fields such as imagery processing, computer-aided architectural design, and analysis of captured images to determine camera parameters. I have also received best paper awards at the International Conference on Computer Vision and at the European Conference on Computer Vision and an IEEE technical achievement award in 2005 for my research. I became an Institute of Electrical and Electronics Engineers ("IEEE") Fellow in 2009, and an ACM Fellow in 2014.

8. I have served as program co-chair for the IEEE Computer Vision and Pattern Recognition (CVPR) in 2000, 2011, and 2018, general co-chair for CVPR

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2006 and 2015, program co-chair for the European Conference on Computer Vision 2008, and have been a regular member of the program committee of all major international conferences on computer vision. I have served six years on the program committee of the international Association for Computing Machinery's Special Interest Group on Computer Graphis and Interactive Techniques and have been a regular reviewer for that conference.

9. Finally, I have also served as a consultant and technical advisor in over twenty various matters.

10. Attached hereto as **Appendix A** is a true and correct copy of my Curriculum Vitae describing my background and experience and includes a list of my publications, presentations, and expert testimony experience.

III. PRIORITY DATE AND ONE OF ORDINARY SKILL

11. I understand that a person of ordinary skill in the art ("POSITA") is a hypothetical person who is presumed to have known the relevant art at the time of the invention. I understand that POSITA is also a person of ordinary creativity, who in many cases will be able to fit the teachings of multiple patents or printed publications together. I further understand that the factors that may be considered in determining the level of ordinary skill in a particular field of art include (1) the level of education and experience of those working in the field, (2) the types of problems encountered in the field, and (3) the sophistication of the technology at the

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time of the invention, which I understand Pictometry asserts to be at least as early as November 8, 2002. I understand that not every factor may be present in every case. I understand that POSITA is not a specific real person, but rather is a hypothetical person having the qualities reflected by the above-discussed factors. I further understand that POSITA would have knowledge from the teachings of the prior art, including the art cited herein.

12. In my opinion, on or before November 8, 2002, POSITA relating to the technology of the '657 patent would at minimum have a bachelor's degree or higher in computer science, computer engineering, computer vision or visualization, physics, electrical engineering, or an equivalent educational background, or at least five years of industry experience in imaging technology.

13. I base this opinion (1) on the level of training I believe is required to practice the concepts stated in the Challenged Claims, and which are described in the prior art; (2) on my decades of experience teaching and contributing to computer vision, computer science, and computer engineering; and (3) on acting as an advisor and consultant (including as to persons of ordinary skill) in that work.

14. Well before November 8, 2002, my level of skill in the art was at least that of POSITA. I am qualified to provide opinions concerning what such POSITA would have known or understood as of that time. Unless otherwise stated, my

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analysis and conclusions provided herein are from the perspective of POSITA as of that date.

IV. MATERIALS RELIED UPON

15. In reaching the conclusions described in this declaration, I have relied on the documents and materials cited in this Declaration and those identified in **Appendix B**. These materials are patents, related documents, and printed publications. Each of these is a type of document that experts in my field would reasonably rely upon when forming their opinions.

16. My opinions are also based on my education, training, knowledge, and personal and professional experience.

V. THE '657 PATENT

17. I have been advised that Pictometry asserts that the Challenged Claims of the '657 patent are entitled to a priority date of at least as early as November 8, 2002. I assume a November 8, 2002 priority date for the purposes of my opinions herein.

A. Overview of the '657 Patent

18. '657 concerns "an apparatus for capturing and geolocating oblique images." EX1001 (**'657**), 3:67-4:1, cl.1, Figs.1, 2:

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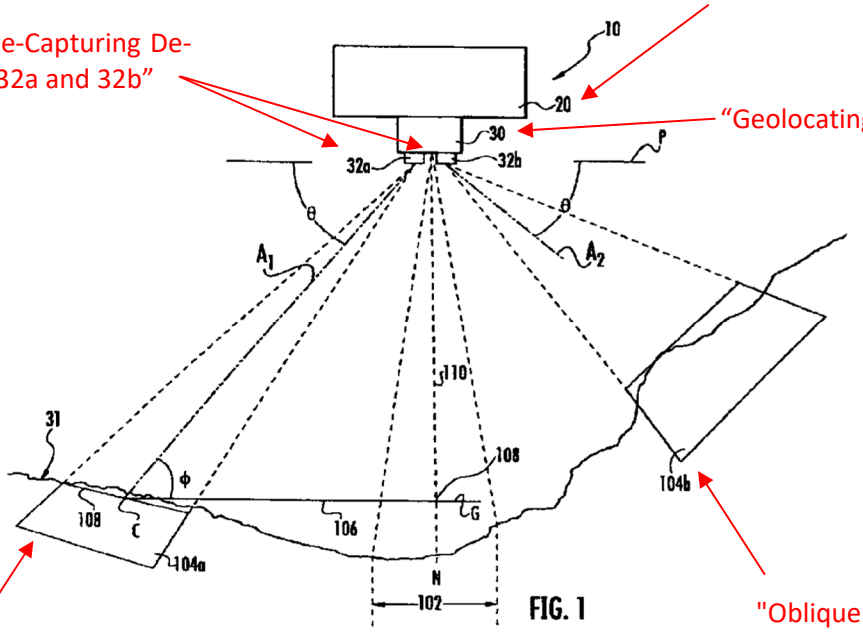


FIG. 1

"Platform or Vehicle 20"

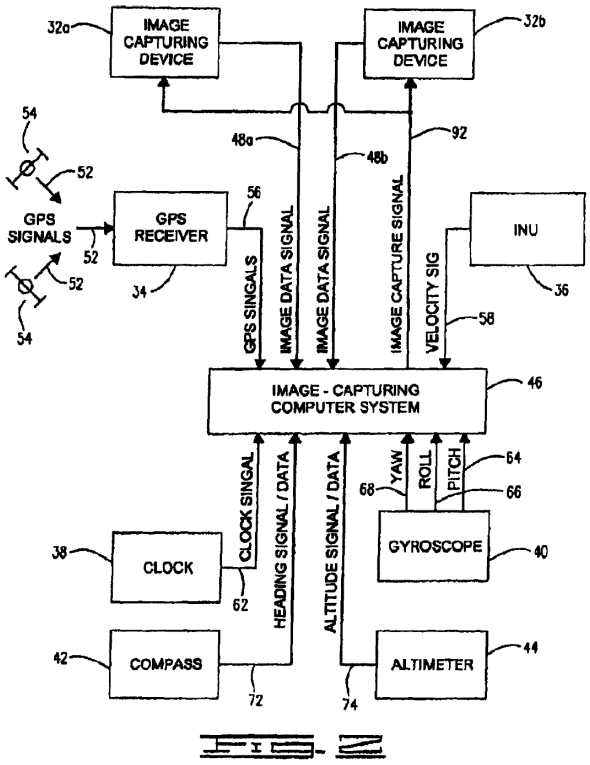
"Image-Capturing Devices 32a and 32b"

"Geolocating System 30"

"Oblique Image 104a" captured by "Image-Capturing Device 32a"

"Orthogonal Image 102"

"Oblique Image 104b" captured by "Image-Capturing Device 32b"



19. The ’657 patent’s claims generally require a first image-capturing device for capturing oblique aerial images (*see* §V.C), transmitting image-data signals corresponding to images captured by the first image-capturing device (*e.g.*, aerial images), a second image-capturing device for capturing aerial images (*e.g.*, a second camera), transmitting image-data signals corresponding to images captured by the second image-capturing device (*e.g.*, aerial images), a geo-locating device (*e.g.*, GPS receiver, altimeter, inertial navigation unit, compass, or clock) issuing a corresponding geo-locating signal indicative at least in part of a geo-location of the first image-capturing device (*e.g.*, latitude and longitude, height, acceleration/pitch, or heading of the camera), a computer system for receiving and storing the image-

data signals and geo-locating signal (*e.g.*, computer with data storage), associating by the computer system of the image-data signals with the geo-locating signal (*e.g.*, associating aerial images with the GPS receiver's latitude and longitude coordinates or geo-location data), and separate control by the computer system of the first and second image capturing devices (*e.g.*, the computer controls and triggers each camera individually). EX1001 (**'657**), cl.1. Claim 3 adds conventional and well-known navigational devices (*e.g.*, compass, altimeter, GPS). EX1001 (**'657**), cl.3. Claims 4, 26, and 27 add well-known ground sample distance requirements for the captured images, which would have been trivial to implement using well-known photography techniques or simply by flying at different altitudes. EX1001 (**'657**), cls.4, 26-27. Claims 5, 19, and 21 simply specify the arrangement (*e.g.*, arranged for capture of orthogonal images) or number (*e.g.*, three cameras) of cameras, a trivial and well-known implementation choice. EX1001 (**'657**), cls.5, 19, 21.

20. I have considered the Challenged Claims (claims 1-5, 14, 19-21, and 26-27) of the '657 patent, which read as follows:

> **Claim 1**
>
> **[1.pre]** A system for capturing images and geo-location data corresponding thereto, comprising:
>
> **[1.a]** a first image-capturing device, said first image-capturing device capturing oblique aerial images[ ] at image-capturing events, said first

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image-capturing device issuing first image-data signals corresponding to captured images;

[1.b] a second image-capturing device, said second image-capturing device capturing images at image-capturing events, said second image capturing device issuing second image-data signals corresponding to captured images;

[1.c] at least one geo-locating device, each said at least one geo-locating device issuing a corresponding at least one geo-locating signal, each said at least one geo-locating signal being indicative at least in part of a geo-location of said first image-capturing device during each first image capturing event;

[1.d] a computer system receiving and storing said first and second image-data signals and said at least one geo-locating signal;

[1.e] the computer system executing image and data acquiring software reading said first and second image-data signals and said at least one geo-locating signal, said image and data acquiring software associating each said first or second image-data signal with a corresponding said at least one geo-locating signal for each image-capturing event; and

[1.f] wherein the computer system transmits image-capture signals to the first image-capturing device and the second image-capturing device to cause the first and second image-capturing devices to capture images, and wherein the computer system controls the first and second image-capturing devices separately.

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Claim 2

[2.pre] The system of claim 1, wherein said at least one geo-locating device and said at least one geo-locating signal respectively comprise at least one of:

[2.a] a clock issuing to said image-capturing computer system time data signals indicative of a time of each said image-capturing event;

[2.b] a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second image-capturing devices at each said image-capturing event;

[2.c] an inertial navigation unit (INU) issuing to said image-capturing computer system velocity data signals indicative of a velocity of said first or second image-capturing device at each said image-capturing event;

[2.d] a gyroscope issuing to said image-capturing computer system a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of said first or second image-capturing device at each said image-capturing event;

[2.e] a compass issuing to said image-capturing computer system heading data signals indicative of a heading of said first or second image-capturing device at each said image-capturing event; and

[2.f] an altimeter issuing to said image-capturing computer system altitude data signals indicative of an altitude of said first or second image-capturing device at each said image-capturing event.

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Claim 3

[3.pre] The system of claim 1, wherein said at least one geo-locating device and said at least one geo-locating signal respectively comprise:

[3.a] a clock issuing to said image-capturing computer system time data signals indicative of a time of each said image-capturing event;

[3.b] a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second image-capturing devices at each said image-capturing event;

[3.c] an inertial navigation unit (INU) issuing to said image-capturing computer system velocity data signals indicative of a velocity of said first or second image-capturing device at each said image-capturing event;

[3.d] a gyroscope issuing to said image-capturing computer system a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of said first or second image-capturing device at each said image-capturing event;

[3.e] a compass issuing to said image-capturing computer system heading data signals indicative of a heading of said first or second image-capturing device at each said image-capturing event; and

[3.f] an altimeter issuing to said image-capturing computer system altitude data signals indicative of an altitude of said first or second image-capturing device at each said image-capturing event.

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Claim 4

[4] The system for capturing images and geo-location data corresponding thereto of claim 1, wherein the first or second image-capturing device captures community level oblique aerial images.

Claim 5

[5] The system for capturing images and geo-location data corresponding thereto of claim 1, wherein the second image-capturing device captures orthogonal images at image-capturing events.

Claim 14

[14] The system for capturing images and geo-location data corresponding thereto of claim 1, further comprising a platform carrying the first and second image-capturing devices through a controlled flight.

Claim 19

[19] The system for capturing images and geo-location data corresponding thereto of claim 14, wherein the first and second image-capturing devices have different angles of declination.

Claim 20

[20] The system for capturing images and geo-location data corresponding thereto of claim 14, further comprising a third image-capturing device, wherein the first and second image-capturing devices are

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capturing oblique aerial images and the third image-capturing device is capturing orthogonal aerial images.

Claim 21

[21] The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the computer system transmits image-capture signals to the first image-capturing device and the second image-capturing device and the third image-capturing device to cause the first, second, and third image-capturing devices to capture images.

Claim 26

[26] The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the first and second image-capturing devices capture community level oblique aerial images.

Claim 27

[27] The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the first and second image-capturing devices capture neighborhood level oblique aerial images.

B. Overview of the '657 Patent Prosecution History

21. The application leading to '657 was filed March 8, 2013 and claims priority to a November 8, 2002 provisional application. EX1002, 4-5. Notably, among other rejections during prosecution, the '657 patent's Examiner rejected then-pending claims 1-2, 4-8, 13, 16-21, 26-28, and 33-35 as anticipated by U.S. Patent

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7,184,072 (primary reference "**Loewen**" (EX1004), filed September 6, 2002 and claiming priority to a June 15, 2001 non-provisional application), finding that Loewen disclosed each and every limitation of those claims. EX1002 (**'657 Prosecution History**), 114-119. In response, PO ***amended*** pending claim 1 to include "a second image-capturing device" and to require that the "computer system ***transmits image-capture signals*** to the first image-capturing device and the second image-capturing device… [and] ***the computer system controls the first and second image-capturing devices separately***." EX1002 (**'657 Prosecution History**), 188-189. The Examiner then allowed the claims. EX1002 (**'657 Prosecution History**), 212-18. PO then submitted a request for continued examination along with an information disclosure statement identifying additional references. EX1002 (**'657 Prosecution History**), 226.

22. The Examiner then rejected claim 1 and others as obvious over Loewen in view of Nims (U.S. Pub. 2003/0164962), finding that Loewen expressly disclosed each and every limitation of claim 1 except for "wherein ***the computer system controls the first and second image capturing devices separately***," EX1002 (**'657 Prosecution History**), 257, for which the Examiner relied on Nims. *Id.*

23. In response, PO did not amend any claims or argue that Loewen did not disclose the other limitations of pending claim 1–instead, PO argued that Nims did not disclose separate camera control because "Nims does not teach any manner of

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how the cameras are controlled. For example, it is possible that the cameras are slaved together such that the cameras are signaled together to all capture images…. This type of 'slaving' of cameras was used in the past to simplify control signals and data processing, such as matching GPS signal data to camera event signal data." EX1002 (**'657 Prosecution History**), 290–291. PO further argued that "one skilled in the art would likely understand that the Nims cameras 16, 18, and 20 were slaved together," and "[t]hus neither Loewen nor Nims," disclosed ***separate camera control*** as required by claim 1. EX1002 (**'657 Prosecution History**), 291-292. The Examiner then allowed the claims. EX1002 (**'657 Prosecution History**), 322-328. Notably, in doing so the Examiner did not have before him EP0053640 (secondary reference "**Fujimoto**" (EX1005), published June 16, 1982), which expressly discloses an aerial imaging system including "computerized control for ***opening the shutters of a plurality of cameras independently of one another***," or any reference cumulative to Fujimoto. EX1005 (**Fujimoto**), ¶0004; *See generally* EX1002 (**'657 Prosecution History**).

C. Claim Construction of the '657 Patent Claims

24. I understand that patented claims terms are generally given their plain and ordinary meaning in light of the specification as understood by POSITA. I also have been advised that the plain and ordinary meaning may not apply where a patentee acts as his own lexicographer, meaning that the patentee sets out his own

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definition for the term or where the patentee disavows the full scope of the claim term either in the specification or during prosecution.

25. I also understand that, during patent examination, the Patent and Trademark Office (PTO) interprets applied-for claims in a manner broader than the interpretation standards described above for patented claims. During examination, I understand that the PTO interprets the claims as broadly as their terms reasonably allow, giving claims in an application their broadest reasonable interpretation consistent with the specification.

26. I have been asked to assume, in the context of the '657 patent, that "the computer system controls the first and second image-capturing devices separately" as used in each of the Challenged Claims means "control data sent by the computer system that cause image-capturing devices to capture images at different interval and/or at different intervals." I have applied this definition in my analysis below. I also understand, however, that Patent Owner asserts in a litigation that "the computer system controls the first and second image-capturing devices separately" includes using one signal sent simultaneously to multiple cameras. As I explain below, regardless of whether the broader construction advocated by PO in litigation (*i.e.*, using one signal sent simultaneously to multiple cameras) or the narrower construction (*i.e.*, control data sent by the computer system that cause image-capturing devices to capture images at different interval and/or at different intervals)

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applies, the prior art references described in the grounds herein render obvious each of the Challenged Claims.

27. I have been asked to assume, in the context of the '657 patent, that "oblique aerial image(s)" as used in each of the Challenged Claims means a "an aerial image capturing a generally trapezoidal area or view of the subject surface or object, with the foreground of the trapezoid having a substantially smaller ground sample distance (i.e., a higher resolution) than the background of the trapezoid." I have applied this definition in my analysis below. I also understand, however, that Patent Owner asserts in a litigation that "oblique aerial image(s)" includes any image taken in which the image-capturing device is aimed or pointed generally to the side of and downward from the platform that carries the image-capturing device. In my opinion, regardless of which construction applies (the narrower construction I have been asked to assume or the broader construction proposed by Patent Owner), the prior art references described in the grounds herein render obvious each of the Challenged Claims.

28. For all other terms, I have been asked to assume that they have their plain and ordinary meaning as they would have been understood by POSITA in light of the specification.

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VI. BACKGROUND ON THE STATE OF THE ART

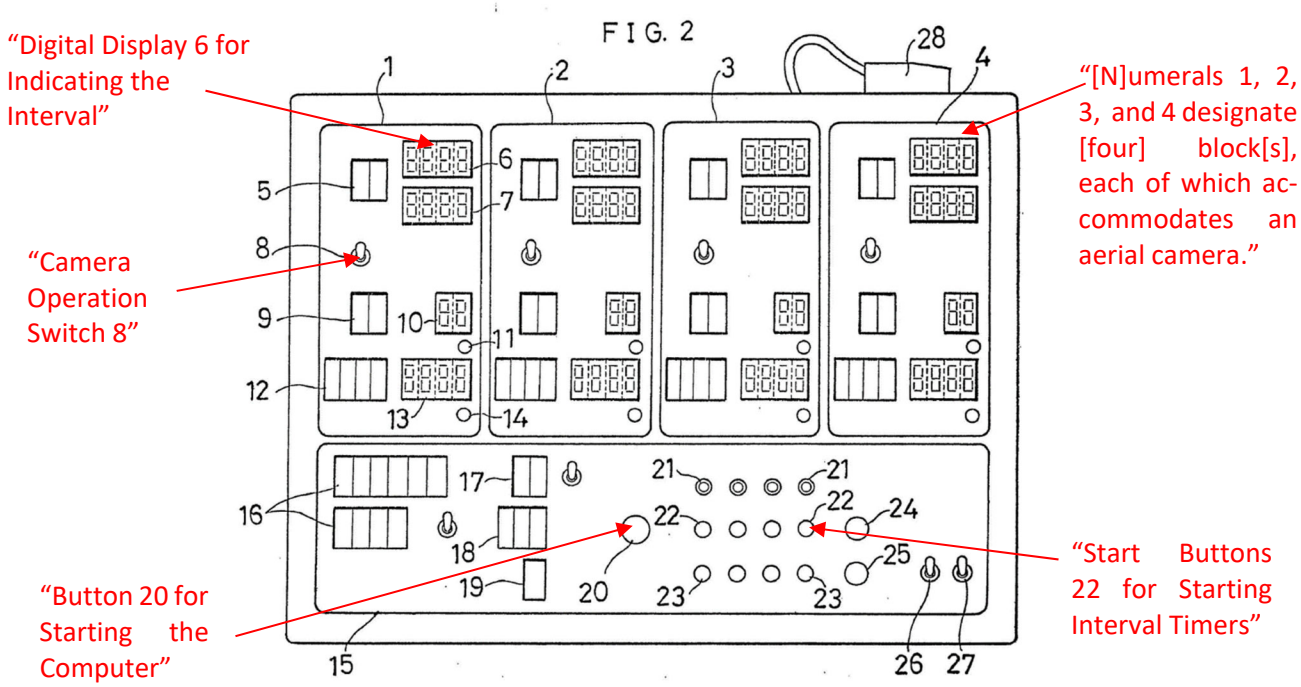
29. In my opinion, prior to November 8, 2002, the prior art disclosed a computer separately controlling a first and a second image-capturing device.

30. As discussed below (*infra* ¶¶31-35), ***the computer system controls the first and second image capturing devices separately*** was well known prior to November 8, 2002.

31. For example, European Patent Application No. 0053650 ("Fujimoto" (EX1005), a secondary reference herein), which was published on June 16, 1982, disclosed separate camera control. Fujimoto described, for example, "a computerized control for opening the shutters of a plurality of cameras ***independently of one another*** thereby to secure a series of photographs of the ground without the waste of film,"[1] *e.g.*, EX1005 (**Fujimoto**), ¶0004, and "signals being produced with respect to all the cameras mounted in the aeroplane, thereby enabling each shutter to be driven at independently different time intervals," *e.g.*, EX1005 (**Fujimoto**), ¶0008, Fig.2 (showing four "block[s]" (1, 2, 3, and 4), each of which "accommodates an aerial camera" which "means that the illustrated control system can control four cameras"):

[1] All emphases and annotations herein added unless otherwise noted.

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32. In addition, Hall, R.J. & Hiscocks, P., "A Microcomputer-Based Camera Control System," Photogrammetric Engineering and Remote Sensing, Vol.56 No.5, 443-446 (April 1990) ("**Hall**" (EX1011), published in April 1990), disclosed "a computer-based control system," EX1011 (**Hall**), Abstract, "capable of controlling up to ***four cameras of three different types***," EX1011 (**Hall**), 1. Hall also disclosed separate camera control: its system included determining "the required firing ***intervals*** for the two cameras," EX1011 (**Hall**), 2, with "***independent overlap control*** for cycling both cameras using either aircraft ground speed from video tracking, or direct entry of previously calculated camera timing intervals," and Hall described that "a flight record entry is made ***every time either of the two***

cameras is fired, *e.g.*, EX1011 (**Hall**), 2 ("check the camera trigger routine to determine if ***a camera*** should be fired"), 3, Fig.3 (showing computer "Controlled Framing" of a camera by "Manual Timing" ("burst mode fires a burst of frames and waits for [an operator-]specified interval before firing another burst") as well as "Grid Timing" ("The timing interval between frames may be automatically calculated by the computer")):

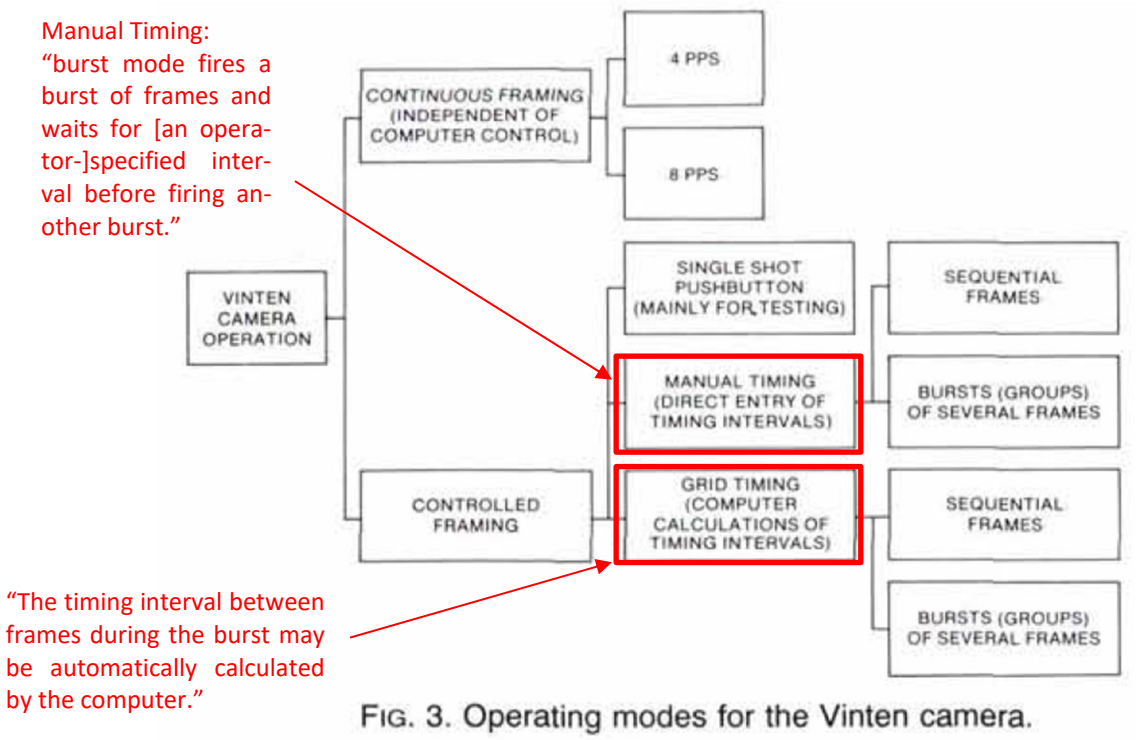


FIG. 3. Operating modes for the Vinten camera.

33. I note that Hall was published in April 1990 in Volume 56, Issue No. 5 of "*Photogrammetric Engineering and Remote Sensing*," a periodical regularly published by a well-known organization (the American Society for Photogrammetry and Remote Sensing), with a copyright date of 1990. EX1011 (**Hall**). Those in my field (including POSITA) were aware of the "*Photogrammetric Engineering and*

Remote Sensing" periodical and regularly looked for papers published in it, thus including EX1011.

34. Further, Held, K.J. & Robinson, B., "TIER II Plus Airborne EO Sensor LOS Control and Image Geolocation," 1997 IEEE Aerospace Conference, Vol.2, 377-405 (1997) ("**Held**" (EX1012), published in 1997), disclosed "a high altitude unmanned reconnaissance aircraft" with multiple image-capture devices including a "mid-wave infra-red (MWIR) staring array" ("IR sensor") and a "CCD visible staring array," ("EO sensor") that are separately controlled from one another: "The EO sensor is controlled by a Kodak camera control unit (CCU) and the IR sensor is controlled by a Hughes EO/IR processor card." *E.g.*, EX1012 (**Held**), 1, 5, Fig.1.3.1:

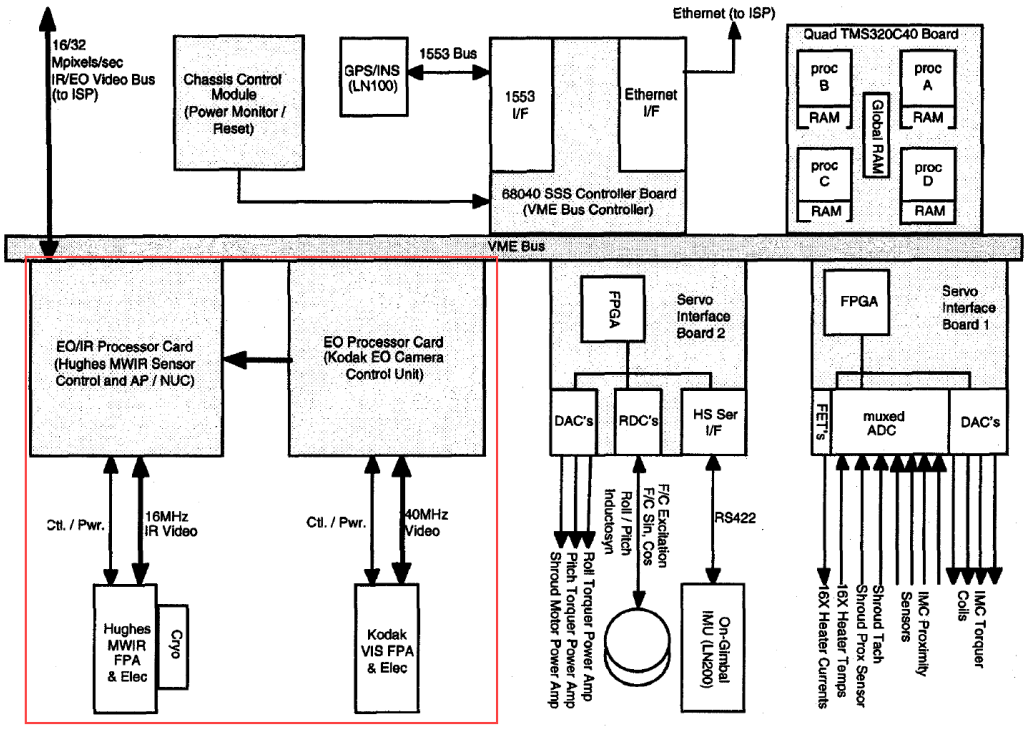


Figure 1.3.1. Sensor Electronics Unit Functional Block Diagram

35. I note that Held was published in 1997 in the "*1997 IEEE Aerospace Conference Proceedings*," a publication related to a regularly-held IEEE conference, and in particular the conference held on February 13, 1997 according to the "Date of Conference" as confirmed on IEEE's IEEE Xplore website (https://ieeexplore.ieee.org/document/577493). I am familiar with the "Date of Conference" dates provided on IEEE Xplore and, in my experience, such dates are accurate. Additionally, in my experience attending IEEE-sponsored conferences, such conferences were well-attended by those in my field (including POSITA), and the presented papers (like EX1012 (**Held**)) were distributed to attendees without confidentiality restrictions—typically online just before the conference, via a conference login, to IEEE members as part of their membership with IEEE, and/or when registering on site at the conference (either as a CD-ROM containing the proceedings or as printed conference proceedings as appropriate for current technologies).

36. Thus, prior to November 8, 2002, a computer separately controlling a first and second image-capturing device (featured as a limitation of the Challenged Claims), was actually widely-known and used by POSITA.

37. As I discuss immediately below with respect to claim 12, for example, the '657 patent's other claimed elements were also well-known long before its priority date, and combining those elements would have been obvious.

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38. ***Multiple image-capturing devices, including image-capturing devices that capture oblique aerial images at image-capturing events, and issue image-data signals corresponding to captured images*** was also well-known long before the '657 patent.

39. For example, U.S. Patent No. 7,184,072 ("**Loewen**" (EX1004), the primary prior art reference relied on herein), which was filed September 6, 2002 and claims priority to a June 15, 2021 non-provisional application, disclosed multiple image-capturing devices that capture oblique aerial images and issue image-data signals, describing, for example, a system for "acquiring images of electric transmission line tower structures," including "a fixed wing aircraft and an arrangement of at least one still camera" (*e.g.*, EX1004 (**Loewen**), Abstract), multiple "still cameras point[ing] rearwardly relative to the line of flight and… arranged to take pictures along an exposure line that is ***at an angle of substantial 30–60 degrees to the horizontal***" (*e.g.*, EX1004 (**Loewen**), 2:39-49, 3:51-57, Figs.6, 8), and that the cameras "write their information directly to the onboard computer system via a well known and conventional firewire connection" (EX1004 (**Loewen**), 6:49-51):

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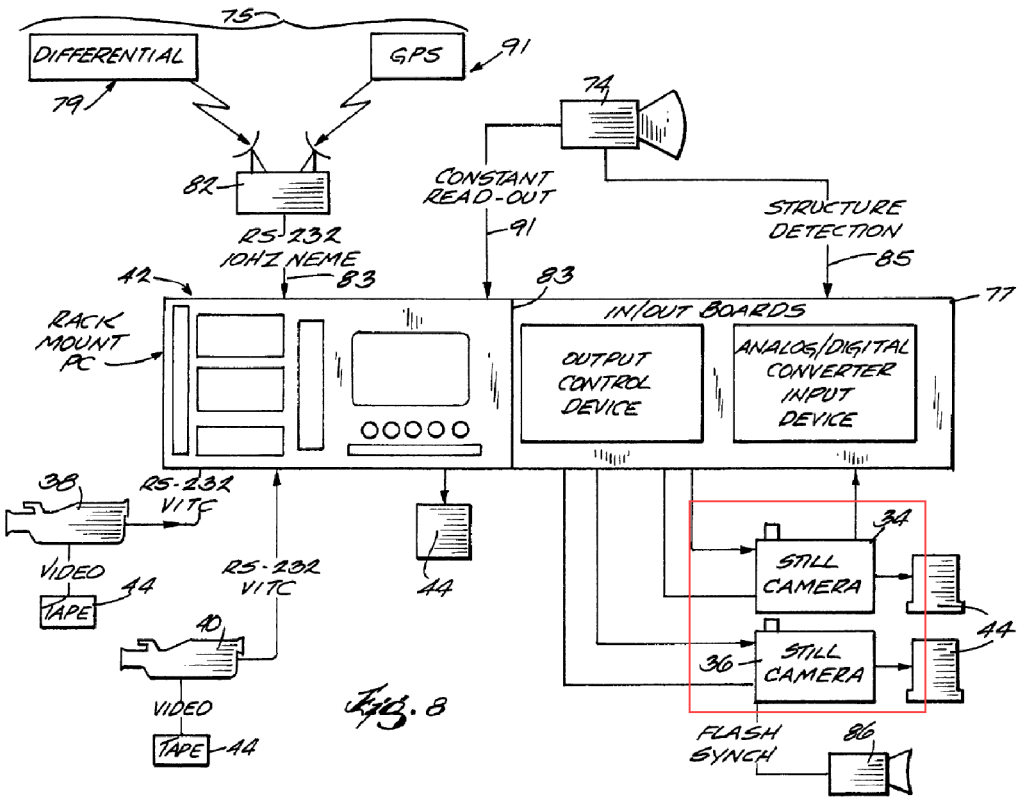


Fig. 8

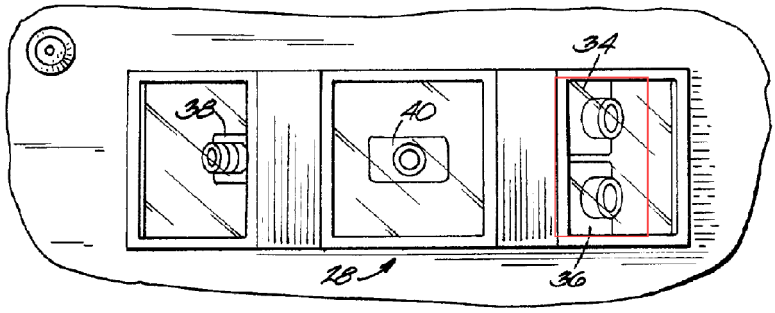
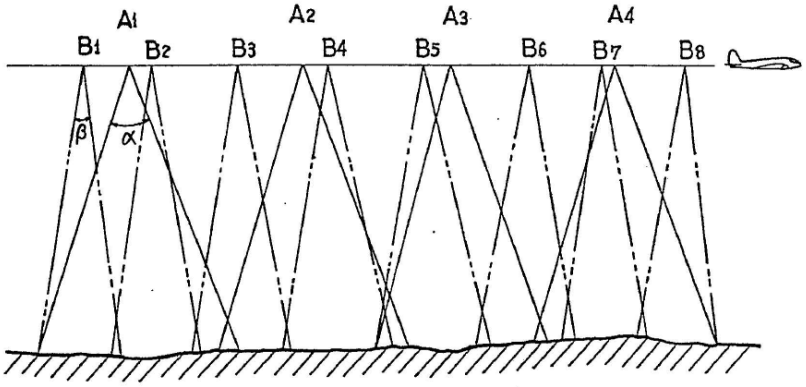


Fig. 6

40. Similarly, Fujimoto disclosed capturing oblique aerial images using multiple image-capture devices, describing, *e.g.*, "an aeroplane having two or more cameras with different lens angles" wherein "[t]he computerized control of the invention can be employed for taking photographs not only vertically but also

obliquely to the ground," *e.g.*, EX1005 (**Fujimoto**), Abstract, Fig.1 (showing different lens angles):

FIG. 1



41. As another example, Mostafa, M.M.R. & Schwarz, K.-P., "Digital image georeferencing from a multiple camera system by GPS/INS," ISPRS Journal of Photogrammetry & Remote Sensing, Vol.56, 1-12 (2001) ("**Mostafa**" (EX1007), a secondary reference herein, which was published in June 2001), disclosed capturing "nadir" (*i.e.*, orthogonal) aerial images and images at an angle using an image-capturing device, describing, *e.g.*, that "imaging data are acquired by two low-cost digital cameras," *e.g.*, EX1007 (**Mostafa**), Abstract, 4 ("image data is collected by two low-cost Kodak DCS420c digital cameras" "one of which… is ***oblique***"), 12 (describing computer single system performing all of its functions: "It is therefore, recommended to design an ***industrial computer system*** that can

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accommodate the necessary boards ***for simultaneous navigation and image data acquisition***."), Fig.6;

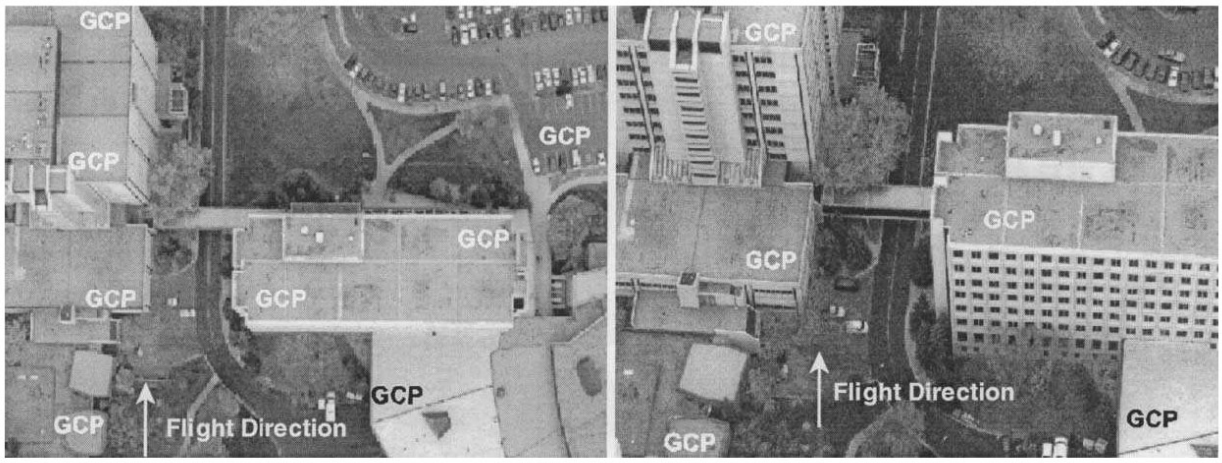
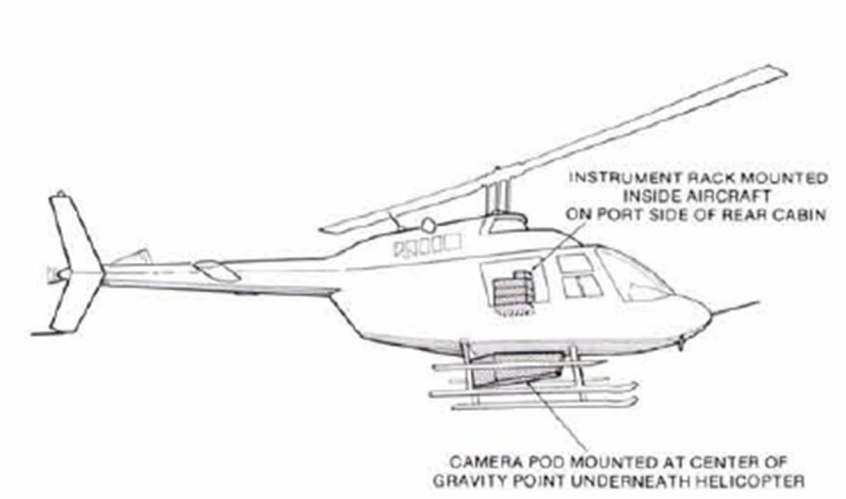


Fig. 6. A nadir digital image (left) and an oblique digital image (right), October 1998 flights.

42. I note that Mostafa was published in June 2001 in Volume 56, Issue No. 1 of the "*ISPRS Journal of Photogrammetry & Remote Sensing*," a periodical regularly published by a well-known publisher (Elsevier Sciences), with a copyright date of 2001. EX1007 (**Mostafa**); EX1017 (showing June 2001 publication date). Those in my field (including POSITA) were aware of the "*ISPRS Journal of Photogrammetry & Remote Sensing*" periodical and regularly looked for papers published in it, thus including EX10007.

43. Hall also disclosed the capture of aerial images using multiple image-capturing devices, describing, *e.g.*, a "camera pod mount[ed] to the underside of [a] helicopter and contains two [] aerial cameras, a radar or laser altimeter and

annotation display unit" (*e.g.*, EX1011 (**Hall**), 1); Fig.1 (showing "[i]llustration of camera pod and instrument rack installed on helicopter")):



44. As a further example, U.S. Patent 7,893,957 ("**Peters**" (EX1010), filed August 28, 2002) disclosed capturing aerial images at an angle using "a camera system having a compound array of imaging sensors disposed in a retinal configuration" including a "first imaging sensor" and "[a]t least one second imaging sensor" that "intersects with the focal axis of the first imaging sensor within an intersection area" (*e.g.*, EX1010 (**Peter**), Abstract), such that, *e.g.*, "[s]patial data—characterizing real estate improvements and locations, roads and highways, environmental hazards and conditions, utilities infrastructures (e.g., phone lines, pipelines), and geophysical features—can now be collected, processed, and communicated in a digital format to conveniently provide highly accurate mapping and surveillance data for various civilian and military applications (e.g., dynamic

GPS mapping)." *E.g.*, EX1010, 1:20-27, Fig.1A (showing image-capturing devices capturing images at angles for, *e.g.*, image sensors 106, 110), 7:

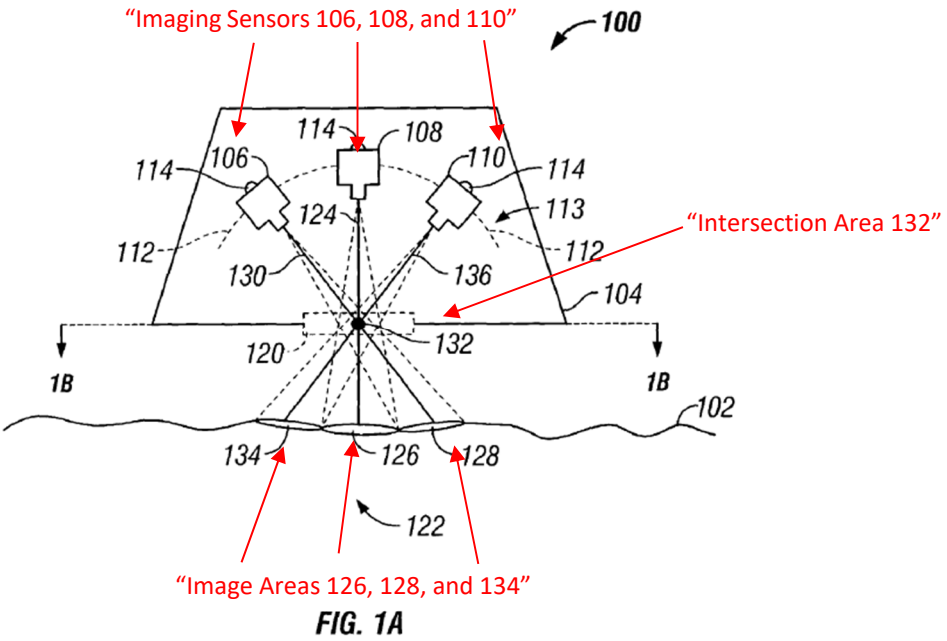


FIG. 1A

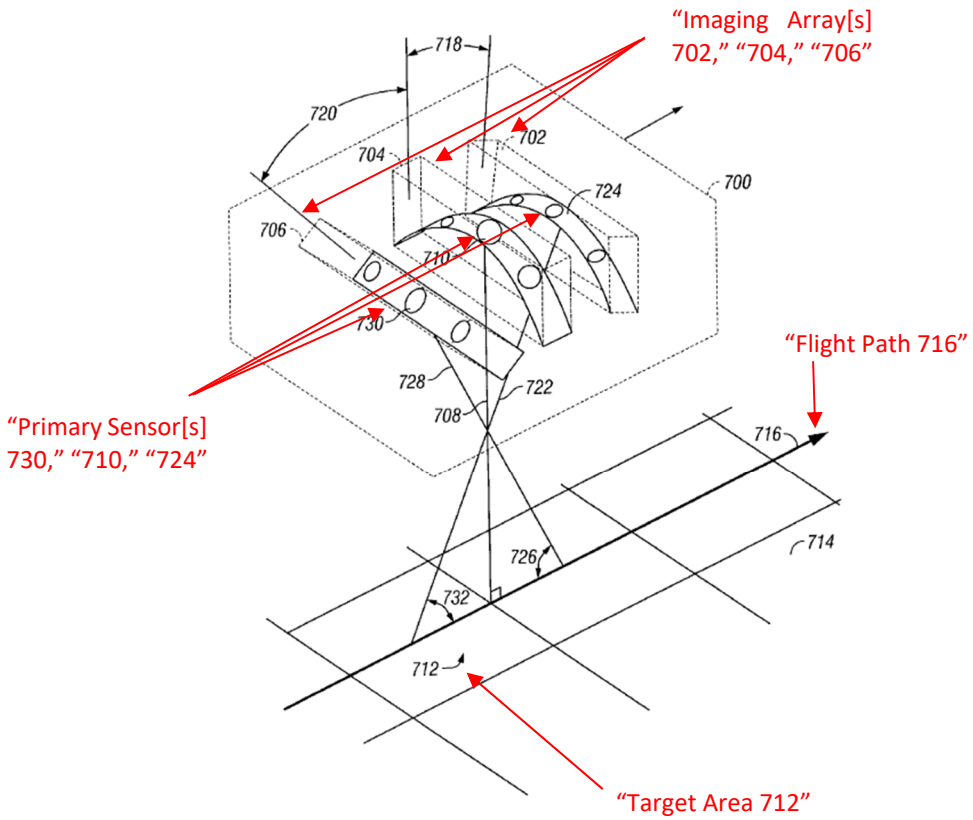


FIG 7

45. ***Geo-locating devices issuing at least one geo-locating signal indicative at least in part of a geo-location of said first image-capturing device during image capturing events*** was also well-known long before the '657 patent.

46. For example, Loewen disclosed "a GPS unit which ***supplies continuous longitude/latitude coordinates***" (*e.g.*, EX1004 (**Loewen**), Abstract), and "recording… longitude/latitude coordinates in ***association with the image***," and further disclosed that a geo-locating signal in the form of GPS data "***is transmitted to the onboard computer***." *E.g.*, EX1004 (**Loewen**), 3:37-50, Fig.8:

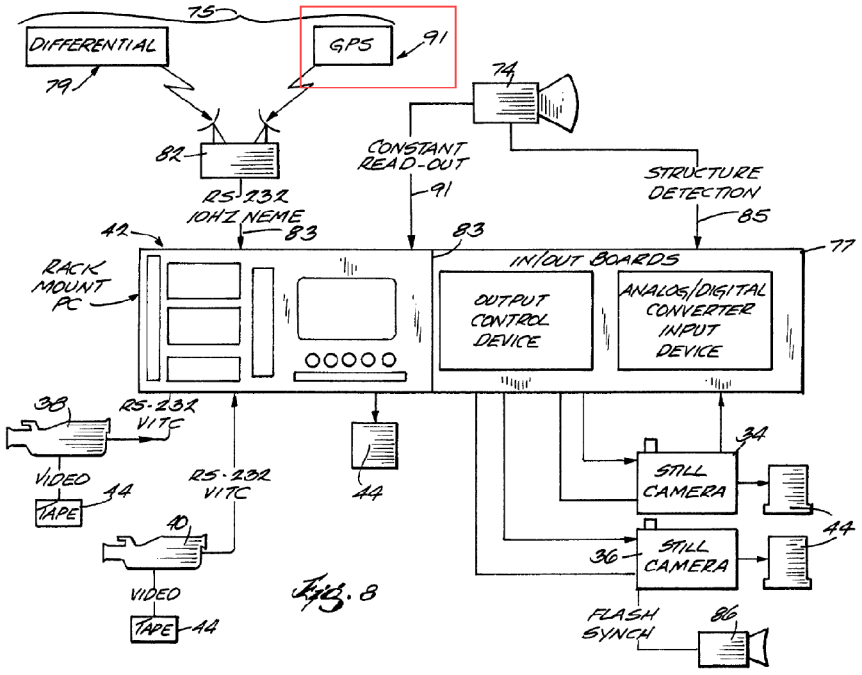


Fig. 8

47. Mostafa similarly disclosed the use of geo-locating signals in the form of GPS data and inertial navigation system data in "an airborne fully digital multi-sensor system for digital mapping data acquisition…. The system acquires two ***streams of data***, namely, ***navigation (georeferencing) data*** and imaging data. The ***navigation data are obtained by integrating an accurate strapdown inertial navigation system with a differential GPS system (DGPS)***…. The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft." *E.g.*, EX1007 (**Mostafa**), Abstract, 2 ("3D vector of coordinates of the exposure station E, ***of any imaging sensor, at the instant of exposure***,"), 4 ("***navigation data is collected using a Honeywell LRF III inertial navigation system, and an Ashtech ZXII GPS receiver***, connected to a portable computer for

raw data acquisition"). Mostafa further described using "***GPS/INS*** interpolated position and attitude angles ***at each exposure station . . . together with the imagery*** to analyze the system performance when using nadir… images." *E.g.*, EX1007 (**Mostafa**), 9, Fig.8 (showing inertial navigation system ("INS") and image-capturing devices together):

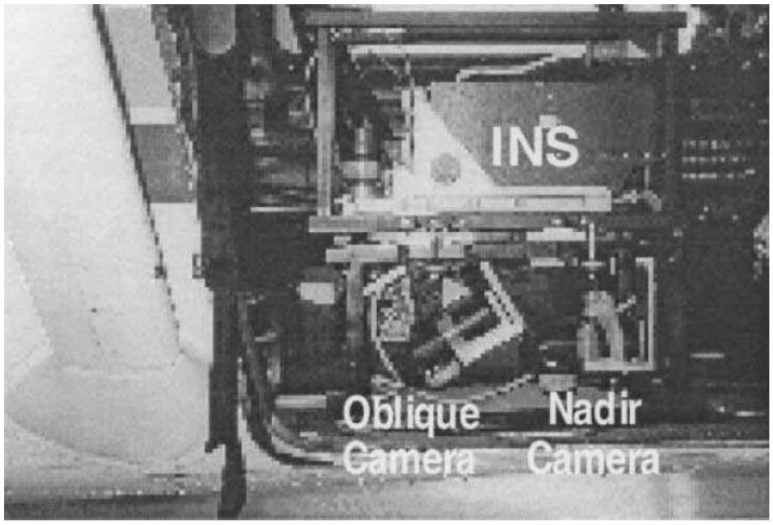


Fig. 8. The multi-sensor system used in the October 1998 test flights.

48. Further, WO 97/35166 ("**Kain 1997**" (EX1008), a secondary reference relied on herein), published September 25, 1997, also disclosed geo-locating signals such as GPS signals, describing, *e.g.*, a "remote data collection system, which may be used in a vehicle such as an aircraft…, [that] ***includes a directional sensor, such as one or more cameras, for sensing a characteristic of interest and providing sensor data… further includes a global positioning system (GPS) receiver for providing GPS data representative of the position of the sensor***, an ***inertial***

measurement unit (IMU) for providing IMU data representative of the attitude of the sensor, a processing unit and a storage unit." *E.g.*, EX1008 (**Kain 1997**), Abstract, 5:32-6:1 ("GPS data accurately represents the position of GPS receiver 46 and therefore represents the position of cameras 20, 22 and 24").

49. U.S. Pub. 2003/0048357 ("**Kain 2003**" (EX1009), another secondary reference relied on herein), filed August 27, 2002, also disclosed geo-locating signals such as GPS signals: an "aerial imaging system has an image storage medium located in an aircraft, a controller that controls the collection of image data and stores it in the storage medium and a digital camera assembly that collects image data" including an "***inertial measurement system (IMU) [that] is fixed in position relative to the camera assembly***" and "***detects acceleration and rotation rates of the camera assembly*** and provides an input signal to the controller." *E.g.*, EX1009 (**Kain 2003)**, Abstract, ¶9, and "***[a] global positioning system (GPS)… detecting the position of the imaging system*** and providing a corresponding input to the controller," *e.g.*, EX1009 (**Kain 2003)**, ¶9.

50. U.S. Patent No. 5,878,356 ("**Garrot**" (EX1006), a secondary reference relied on herein), issued March 2, 1999, disclosed geo-locating signals including, *inter alia*, signals from a GPS, gyroscope, and compass, describing, *e.g.*, an "imaging system comprising… a system for georeferencing the acquired signals," including "a receiver adapted to receive signals from a global positioning system."

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E.g., EX1006 (**Garrot**), Abstract, 4:66-5:2, 12:24-29 ("input data includes… the raw input files of a… compass"), Fig.1 (showing "a block diagram of the imaging system" including "GPS Receiver 20" and "GYRO" 26), Fig.3:

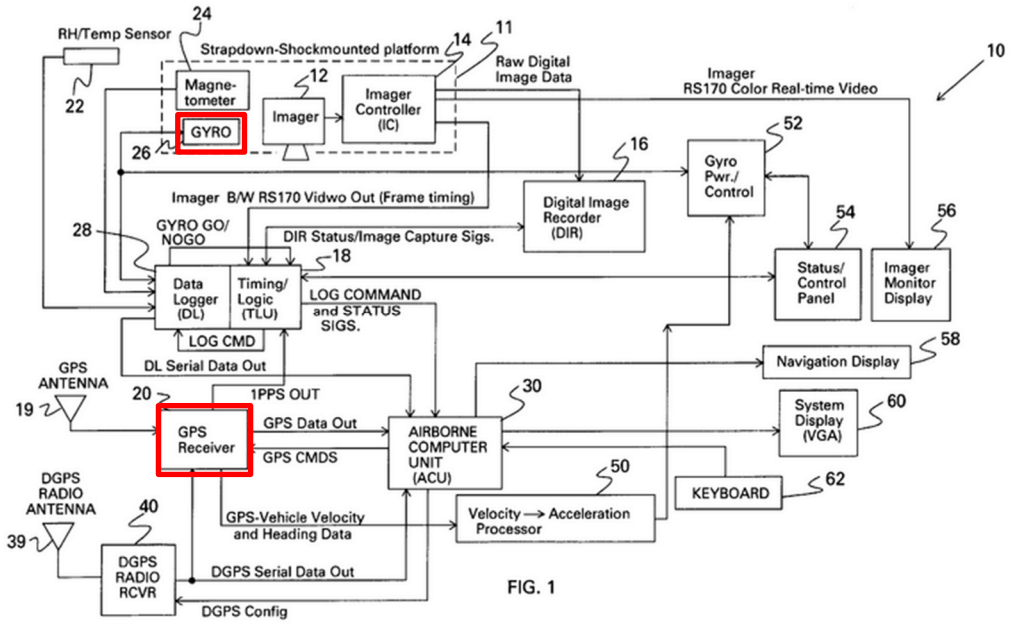


FIG. 1

51. As another example, International Patent Application Publication No. WO 99/18732 ("**Ciampa**" (EX1015)), which published April 15, 1999, disclosed "the capture and automatic georeferencing of a camera and/or images captured by the camera" (EX1015, 1:4-10) through the use of geo-locating devices, particularly, through "a data unit containing a Global Position Satellite (GPS) antenna/receiver, including but not limited to differential GPS or other type GPS system, a compass and inclinometer" and "provides camera coordinates and triaxial angle data." *E.g.*, EX1015, 2:10-18. Ciampa further discloses that the "inclinometer, the GPS antenna/receiver and a compass are affixed to the camera so that they move together

as a unit. The inclinometer detect changes in the depression angle and the roll angles of the camera…." *E.g.*, EX1015, 3:3-6; Figs.1 (showing geo-locating devices "GPS Antenna 15a," "GPS Receiver 15b," "Inclinometers 12," "Compass 14," and "Altimeter 16"), 2 (showing step 103: "record camera altitude, ground location, tile, declination, heading"):

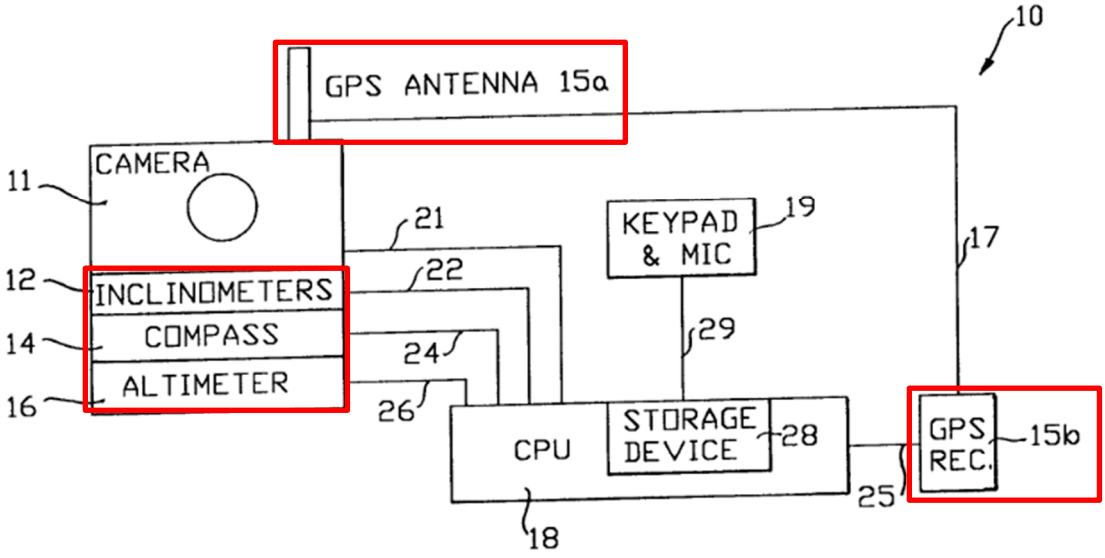


FIG. 1

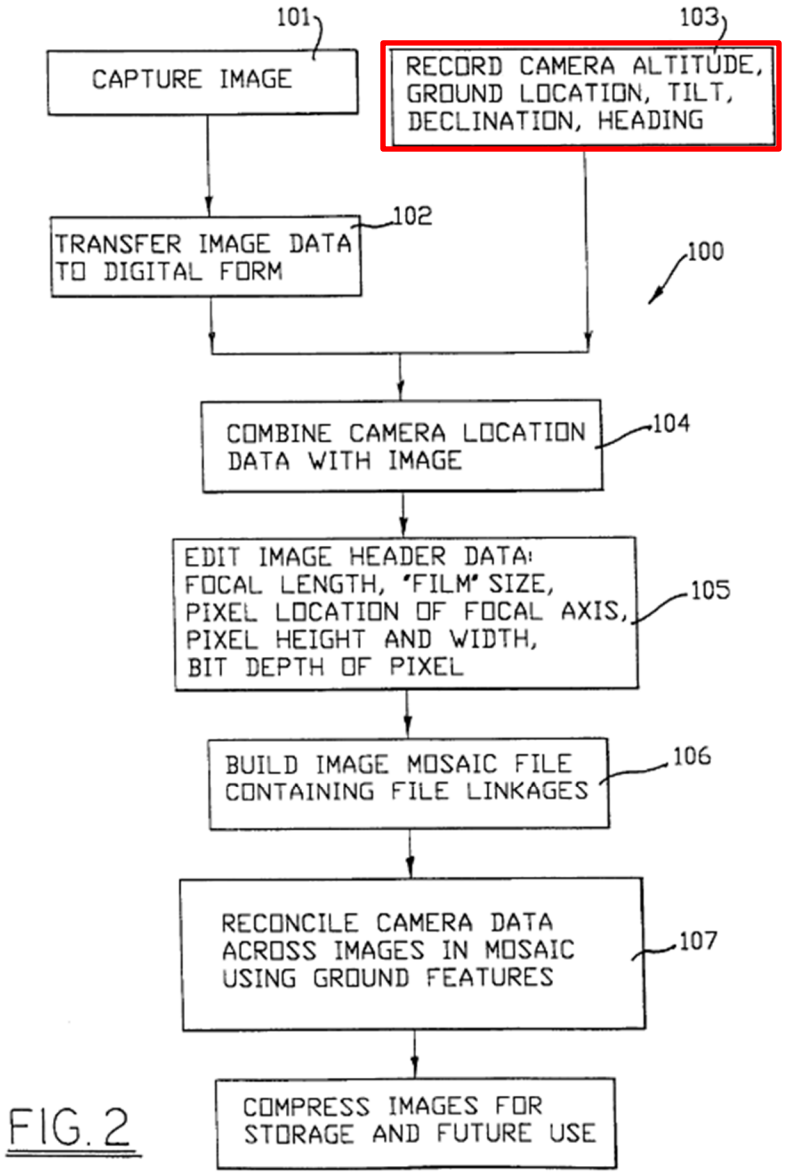


FIG. 2

52. ***A computer system that receives and stores image-data and/or geo-locating signals*** was also well-known long before the '657 patent. *See also* ¶¶38-51.

53. For example, Loewen disclosed that its onboard computer receives and stores both image-data and geo-locating signals: the "***position of the aircraft in longitude and latitude coordinates***" is "***transmitted to the onboard computer and***…

is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower. ***This recording of the tower location in longitude/latitude coordinates in association with the image of each tower provides an inventory database*** of all of the towers along a particular transmission line"; and Loewen describes that "***cameras… write their information directly to the onboard computer*** via a well known and conventional firewire connection." *E.g.*, EX1004 (**Loewen**), 3:38-49, 6:45-51, 7:17-20, 3:51-54, 10:30-34, Fig.8 (including "Rack Mount PC" (*i.e.*, "Onboard Computer 42") connected to "Still Camera[s]" and "GPS"):

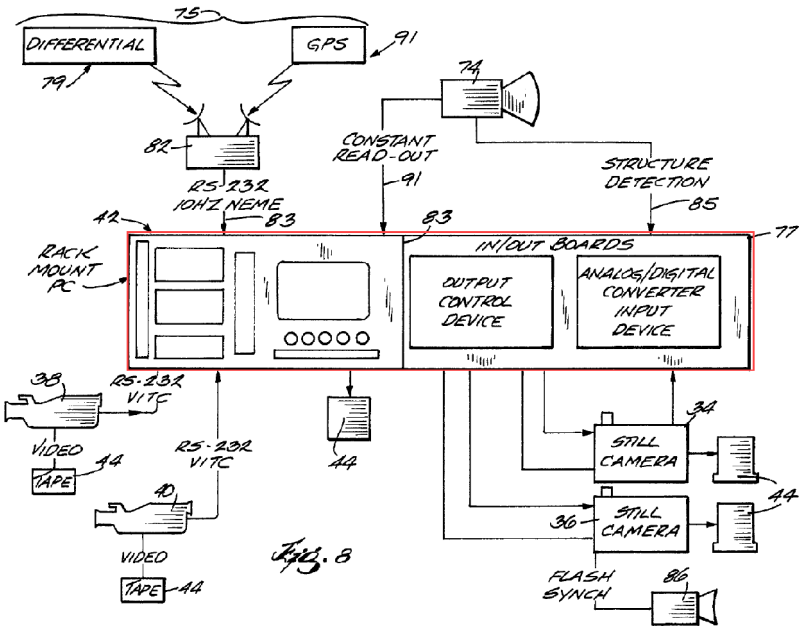
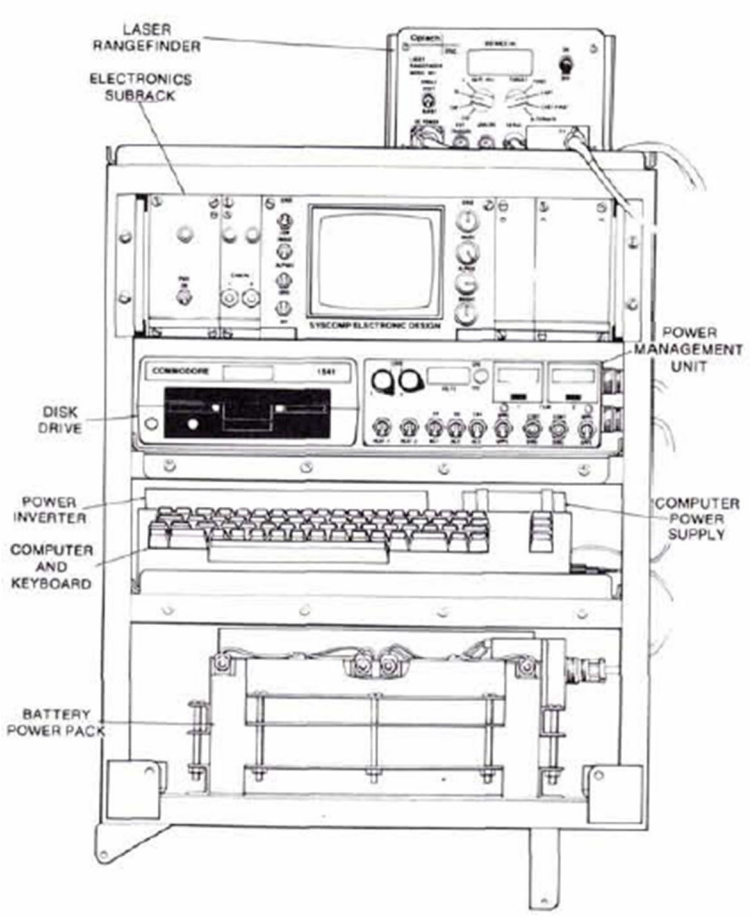


Fig. 8

54. As a further example, Garrot disclosed receiving and storing both image-data and geo-locating signals: its "Airborne Computer Unit (ACU)" "effect[s] centralized control of GPS timing and position data" and includes "[s]oftware for

real-time logging of data (GPS and data-logger, sensors)," and its "Data Logger Unit," *e.g.*, "logs the Imaging Platform's pitch and roll [and] magnetometer (to calculate aircraft heading)." *E.g.*, EX1006 (**Garrot**), 7:36-38, 7:53-54, 8:62-65, Fig.1

55. Hall also disclosed receiving and storing geo-locating signals, describing, *e.g.*, a "camera control system" in the form of a "computer [] responsible for… timing the cameras, and acquiring data from a radar or laser altimeter[,] [t]he disk drive stor[ing] the operational programs for the system and the height data from the flight mission." *E.g.*, EX1011 (**Hall**), 1, 2, Fig.2:



56. Kain 1997, too, disclosed receiving and storing geo-locating signals, describing, *e.g.*, "a processing unit and a storage unit" that "determines geographic data referenced to the sensor data in response to the GPS data and IMU data." *E.g.*, EX1008 (**Kain 1997**), Abstract; Fig.1 ("GPS receiver 46 supplies GPS data and a GPS clock to the system computer 30"):

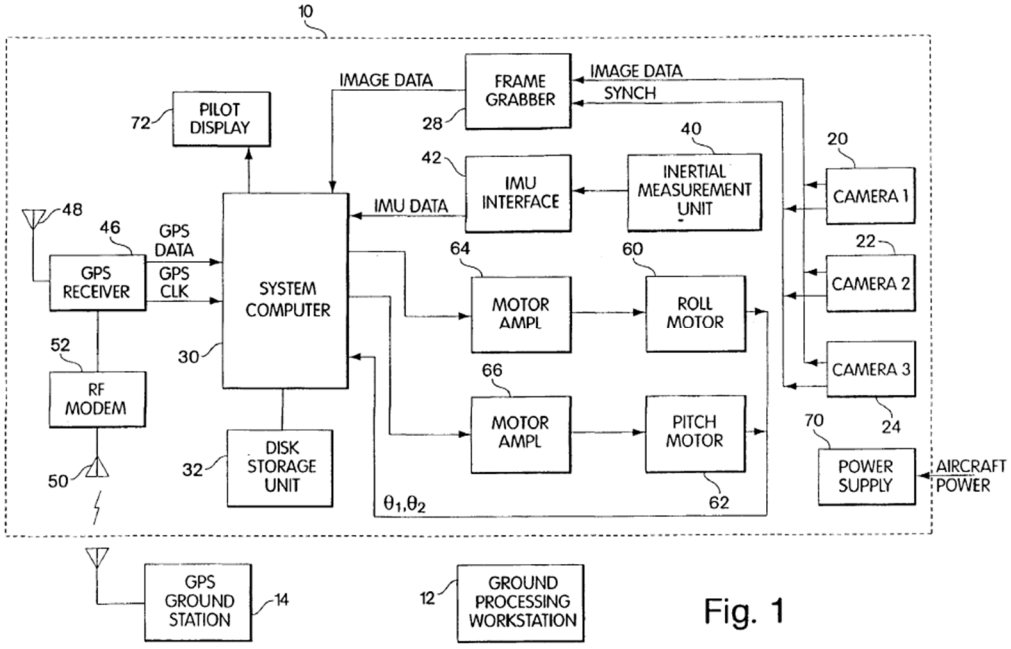


Fig. 1

57. Further, Ciampa disclosed a system in which "[t]he inclinometer, the GPS antenna/receiver and a compass are affixed to the camera so that they move together as a unit. The inclinometer detect changes in the depression angle and the roll angles of the camera. ***The photographic data [(i.e., from "the inclinometer, GPS antenna/receiver, and a compass")] is attached to the image file and is transferred to a small microprocessor (CPU), where the storage device can be a PCMCIA memory card. The microprocessor processes and links the shot data***

from the instruments with a digital image file. All of the data regarding depression angle, global position, heading (or bearing) and image are interpolated and combined with the shot time. This digitized image and other information are then stored in a spatially managed image file mosaic software, whereby images can be retrieved based on their map location or from a gallery or 'contact sheet' of digital miniature thumbnails." *E.g.*, EX1015, 3:3-16; Figs.1 (showing flow of data to "CPU 18" and "Storage Device 28" from "Camera 11" and instruments, *i.e.*, "Inclinometers 12," "Compass 14," "Altimeter 16," and "GPS Receiver 15b"; through "Lines 21, 22, 24, 26, and 25"), 2 (showing a final step of flow diagram of "Compress images for storage and future use"):

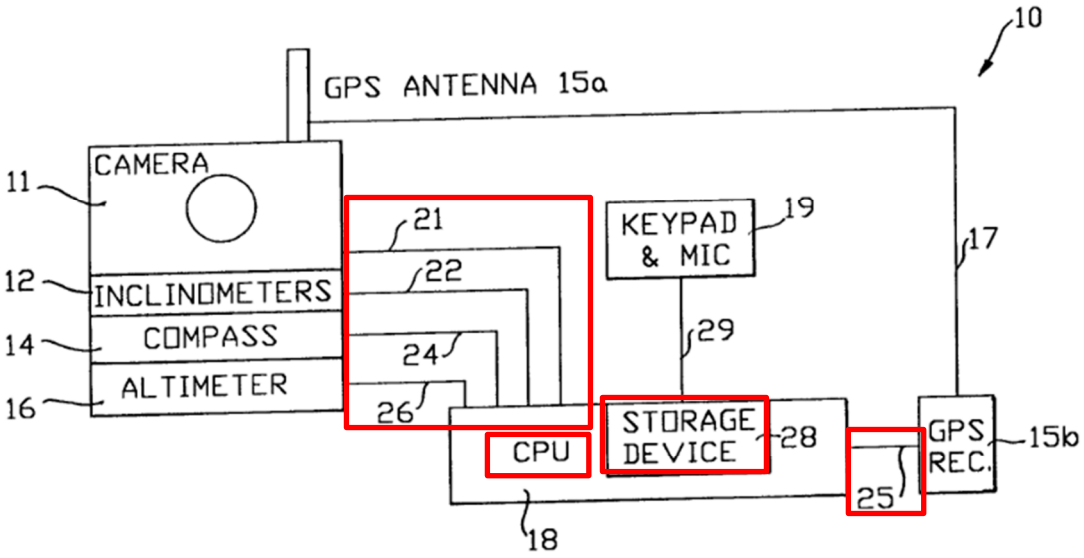


FIG. 1

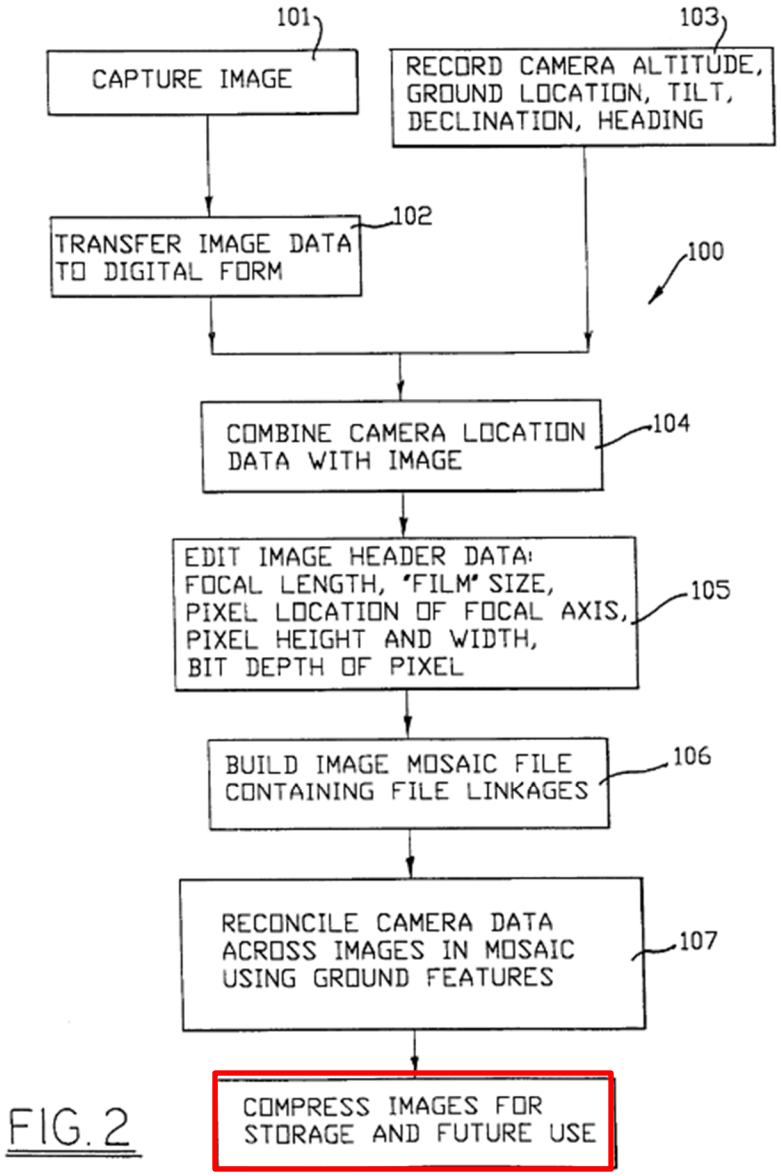


FIG. 2

58. ***A computer system that associates image-data signals to corresponding geo-locating signals*** was also well-known long before the '657 patent. *See also* ¶¶52-57.

59. For example, Loewen disclosed that its onboard computer associates image-data signals to corresponding geo-locating signals, describing, *e.g.*, "an onboard computer (a central processing unit) containing operational software

operatively connected to the cameras and the tower detecting device" and "embedding the longitude/latitude coordinates for… the still camera output." *E.g.*, EX1004 (**Loewen**), 3:3-7, 3:37-50 ("GPS… data is transmitted to the onboard computer and… embedded in the collected data in association with the image of a particular tower structure"), 9:7-11.

60. Garrot similarly disclosed associating image-data with geo-locating signals, including an "imaging system comprising a sensor mounted in the aircraft in a known orientation, circuitry for ***acquiring signals generated by the sensor from a scanned area, [and] a system for georeferencing the acquired [image] signals***." *E.g.*, EX1006 (**Garrot**), Abstract, 4:66-5:2.

61. As another example, Kain 2003, too, disclosed correlating image-data and geo-locating signals: "***the precise attitude and position of the camera*** assembly is known at the time the cameras are triggered. This information ***may be correlated with the pixels of the image*** to allow the absolute coordinates on the image to be determined." *E.g.*, EX1009 (**Kain 2003**), ¶34.

62. Kain 1997 similarly disclosed associating image-data and geo-locating signals, describing, *e.g.*, a prior-art "system including a CCD camera and a global positioning system receiver for ***recording an image signal and position information on magnetic tape***." *E.g.*, EX1008 (**Kain 1997**), 2:14, 19-22.

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63. And Ciampa disclosed associating "image and shot data" (*i.e.*, location data, inclination, and heading or bearing as derived from instruments) for the purpose of "produc[ing] an automatically computationally georeferenced digital image." *E.g.*, EX1015, Abstract. Ciampa explains, *inter alia*, that the purpose of its invention is "the capture and automatic georeferencing of a camera and/or images captured by the camera… and, more particularly, [] a system and method of obtaining precisely located, oblique, digitized land images, taking into account diverse topography and varying camera angles, including changes in heading, roll and yaw." *E.g.*, EX1015, 1:4-10. As Ciampa further disclosed, "[t]he data unit [(*i.e.*, instruments including GPS antenna/receiver, inclinometers, and compass)] provides ***camera coordinates and triaxial angle data, which are combined with the digital representations of the photographic image***. Trigonometric formulas correlate to the image pixel and corresponding ground coordinates." *E.g.*, EX1015, 2:14-18. And "[t]he photographic data is attached to the image file and is transferred to a small ***microprocessor (CPU)… [which] processes and links the shot data from the instruments with a digital image file***." *E.g.*, EX1015, 3:6-10; Fig.2 (showing step 104: "***combine*** camera location data with image"):

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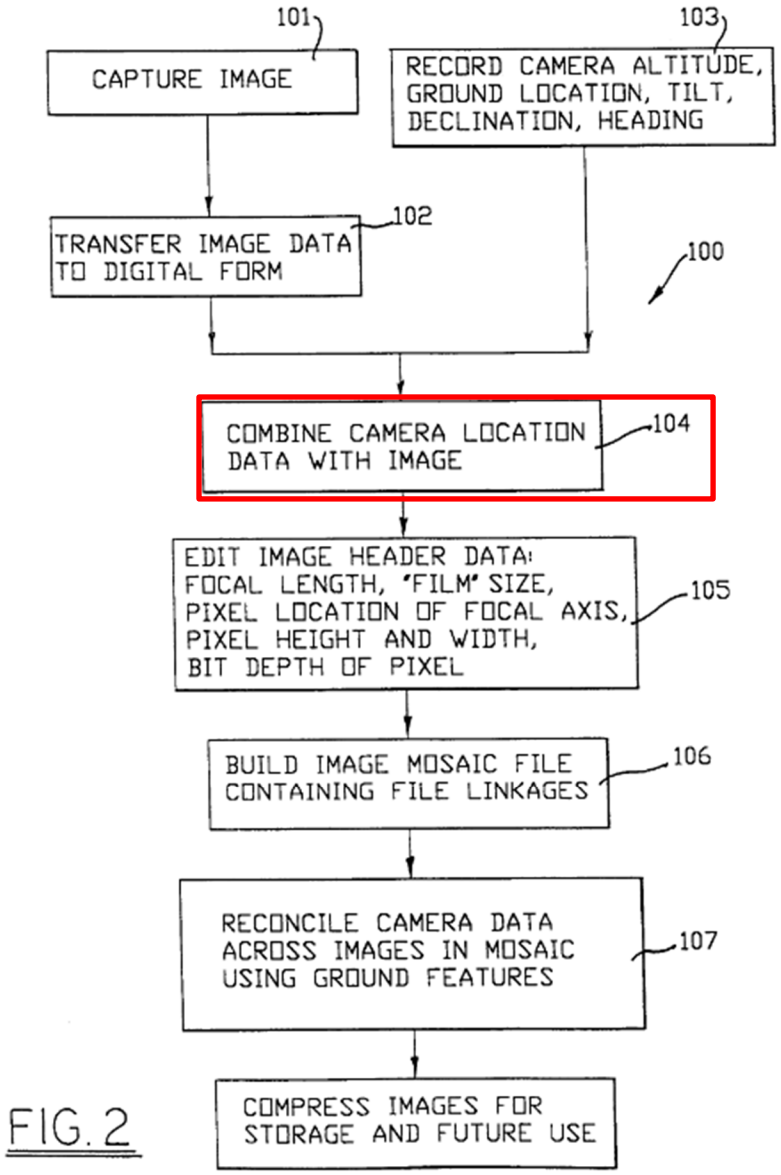


FIG. 2

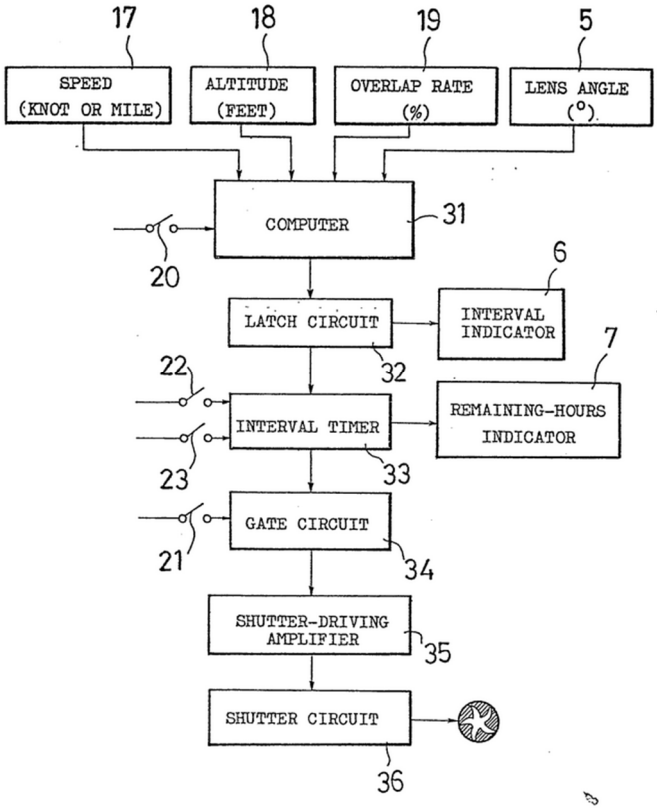
64. ***A computer system that transmits image-capture signals to the image-capturing devices to cause the image-capturing devices to capture images*** was also well-known long before the '657 patent. *See also* ¶¶30-36.

65. For example, Loewen disclosed that its onboard computer transmits image-capture signals to its system's image-capturing devices, describing, *e.g.*, "a ***mechanism 74 for triggering the still cameras to acquire the images***" wherein the

"still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line." *E.g.*, EX1004 (**Loewen**), 7:14-17, 3:7-10, Figs.9-10.

66. Fujimoto disclosed that its computer transmits independent image-capture signals to each of its system's image-capturing devices: "computerized control for aerial photography includes… an output device for producing shutter driving signals… thereby enabling each shutter to be driven at independently different interval time," *E.g.*, EX1005 (**Fujimoto**), ¶0006; Fig.3:

FIG. 3



67. As another example, Hall disclosed a computer system transmitting image-capture signals to image-capturing devices, describing, *e.g.*, "an advanced control system for… cameras" which "included a… computer and is capable of controlling up to four cameras of three different types," and uses various "camera parameters" to calculate "firing intervals for the two cameras" with information "then passed to the machine-code timing-routine for the actual triggering of the cameras." *E.g.*, EX1011 (**Hall**), 1-2.

68. As a further example, Held disclosed a computer system using independent processor cards that control each of its sensors by transmitting image-capture signals: "EO sensor is controlled by a Kodak camera control unit (CCU) and the IR sensor is controlled by a Hughes EO/IR processor card." *E.g.*, EX1012 (**Held**), 5; Fig.1.3.1 (showing the use of independent processor cards that control each of the sensors independently):

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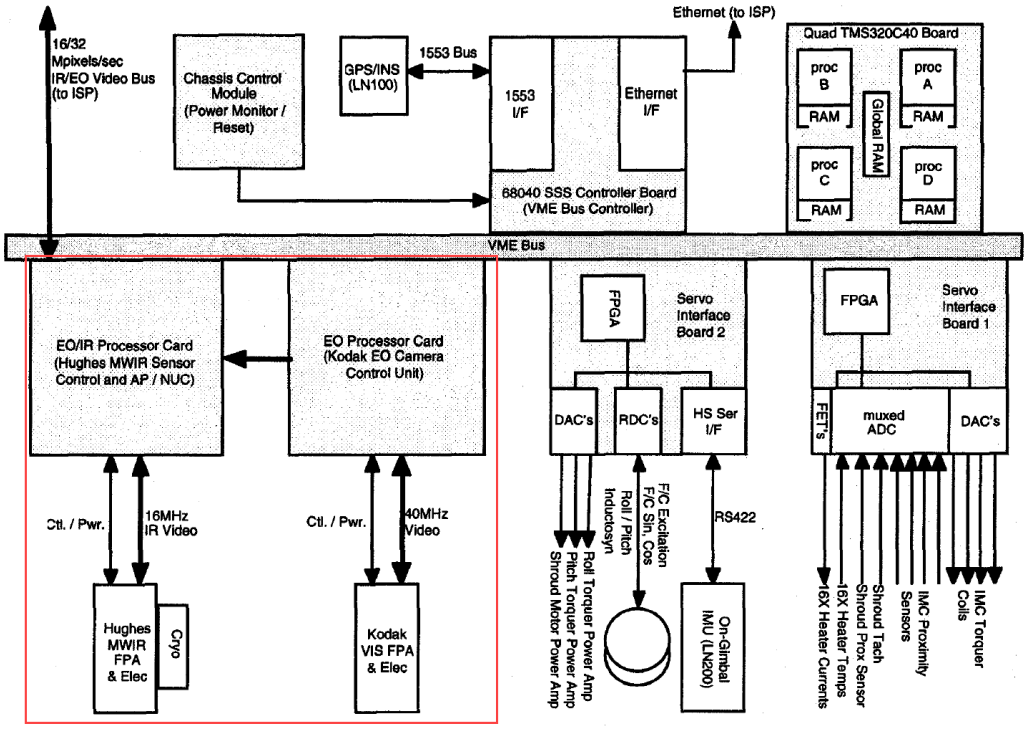


Figure 1.3.1. Sensor Electronics Unit Functional Block Diagram

69. Kain 2003, too, disclosed a computer system transmitting image-capture signals to image-capturing devices: *e.g.*, "[c]ontrol of the imaging system is maintained by a controller that is located within the aircraft and to which the camera assembly 12 is electrically connected." *E.g.*, EX1009 (**Kain 2003**), ¶¶23, 31 ("***cameras… are triggered by the controller***").

70. And Garrot also disclosed a computer system transmitting image-capture signals to image-capturing devices: "Airbone Computer Unit (ACU) 30 produces an image strobe command" that "is received by a Timing and Logic Unit (TLU) 18 and a corresponding signal is sent to a Digital Image Recorder (DIR) 16 just before the desired image frame."" *E.g.*, EX1006 (**Garrot**), 6:48-56 ("the

imaging system 10 collects digital imagery at specified intervals depending upon the flight altitude and aircraft speed"), Fig.1:

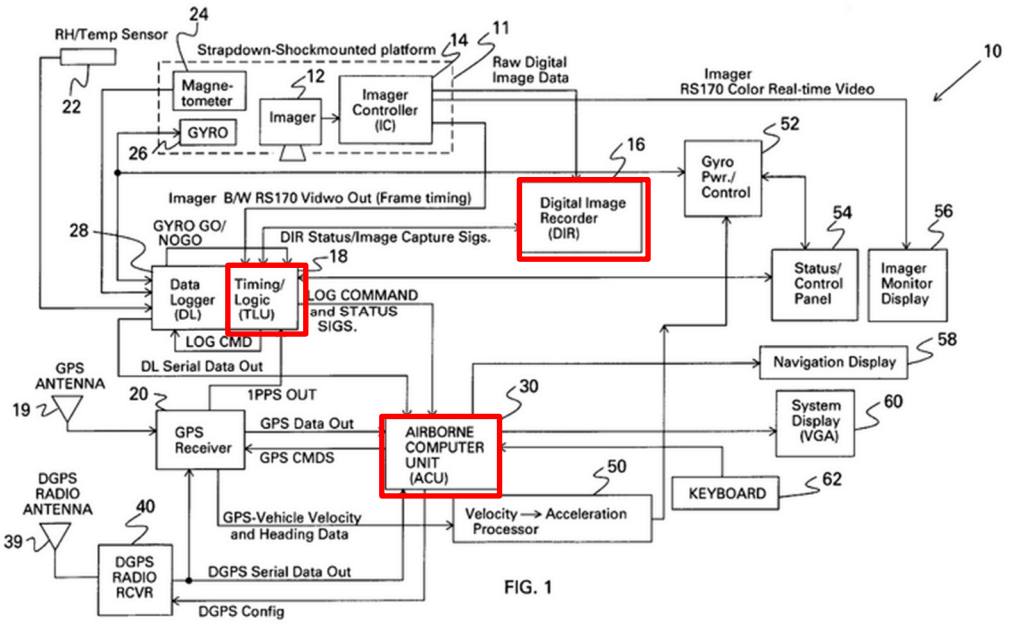


FIG. 1

VII. THE CHALLENGED CLAIMS ARE INVALID

A. Legal Standards

71. I understand that a claim may be invalid under 35 U.S.C. § 103(a) if the differences between the claimed invention and the prior art are such that the claimed invention, as a whole, would have been obvious to a hypothetical person of ordinary skill in the art in view of a prior art reference or a combination of references at the time the claimed invention was made.

72. I have been advised that obviousness is determined from the perspective of POSITA and that the claims of the patent should be read from the point of view of such a person at the time the claimed invention was made. Additionally, I understand that a person of ordinary skill in the art is assumed to know and to have read all relevant prior art in the field of endeavor covered by the patent in suit or reasonably pertinent to the particular problem that the inventor faced.

73. I understand that prior art used in an obviousness analysis must be analogous to the ’657 patent. To determine whether prior art is analogous, I understand that there are two criteria: (1) whether the art is from the same field of endeavor as the invention, regardless of the problem addressed, and (2) if the reference is not within the same field of endeavor as the invention, whether the reference is still reasonably pertinent to the particular problem the inventor faced.

74. I understand that an analysis of whether a claimed invention would have been obvious should be considered in light of the following: (1) the scope and content of the prior art; (2) the differences (if any) between the prior art and the claimed invention; (3) the level of ordinary skill in the pertinent art involved; and (4) secondary considerations of non-obvious. I also understand that a prior art reference should be viewed as a whole.

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75. I further understand that a prior art reference can disclose a claimed feature because the feature is expressly described, or because the feature is inherent in the disclosure and something is inherent in a prior art reference only if the missing descriptive matter must necessarily be present. I understand that for a claimed feature to be described in a prior art reference, the exact words of the claim need not be used. I further understand that inherency cannot be established by probabilities or possibilities, and that the mere fact that something may result from a given set of circumstances is not sufficient to show inherency.

76. In considering whether an invention would have been obvious, I understand that one may consider whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by POSITA. I further understand that other principles may be relied on to determine whether a claimed invention would have been obvious, including:

- Combining elements in the prior art according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of such device or

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technology, either in the same field or in a different one, so that if a person of ordinary skill can implement a predictable variation, it is likely obvious;

- If it would be recognized by POSITA that applying a known technique, which has been used to improve one device, method, or product, would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond the skill of POSITA;
- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing such a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls;
- One of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;

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- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;
- Common sense teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A person of ordinary skill in the art is also a person of ordinary creativity, and is not an automaton;
- A patent claim can be proved obvious by showing that the claimed combination of elements was "obvious to try," particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a person of ordinary skill in the art would have had good reason to pursue the known options within his or her technical grasp; and
- One should be cautious of using hindsight in evaluating whether a claimed invention would have been obvious.

77. I have been advised that when determining whether or not the claimed invention would have been obvious to POSITA, one may consider whether certain objective factors are present. These objective factors include commercial success,

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long-felt but unmet need, teaching away, unexpected results, copying, and praise by others. These factors are generally referred to as secondary considerations or objective indicia of non-obviousness. I understand that there must be a causal relationship (called a "nexus") between the claim and the evidence, and that this nexus must be based on a novel element of the claim rather than something in the prior art. I further understand that even if secondary considerations of non-obviousness are present, secondary considerations are not sufficient to overcome primary evidence of obviousness that is sufficiently strong.

78. I understand that for a claim to be obvious, POSITA must have had, in addition to a motivation to combine, a reasonable expectation of success in practicing the claimed invention based on the prior art. Whether POSITA would have had a reasonable expectation of success in practicing the claims is determined based on the degree of unpredictability in the art as well as the guidance provided by the art.

79. I understand that for *inter partes* reviews, invalidity (also called unpatentability) must be shown under a preponderance of the evidence standard, which I understand means it must be proven to be more likely true than not true.

80. I have concluded each of the Challenged Claims is invalid (and unpatentable) for obviousness based on the references described below and as outlined in the claim charts attached hereto as **Appendix C**.

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B. Grounds 1-7

81. In my opinion, for the reasons described herein and in Appendix C (which forms part of my analysis), POSITA would have recognized that each and every limitation of the Challenged Claims, combined as claimed, is disclosed and suggested by the prior art such that each of the Challenged Claims would have been obvious to POSITA. Specifically, it is my opinion that the Challenged Claims are invalid as obvious as follows:

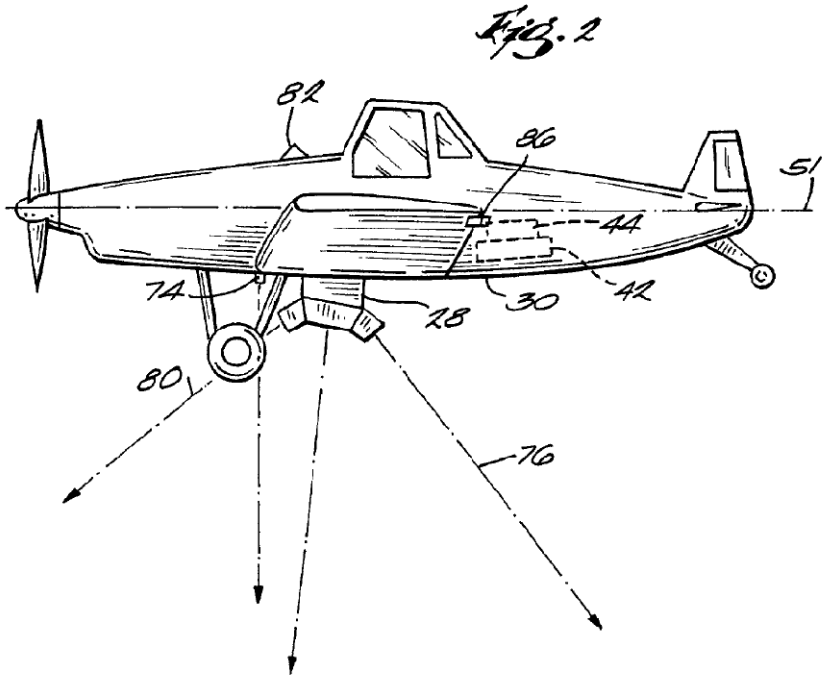
Ground	Claims Challenged	References/Basis
1	1, 5, 14, 19, 20, and 21	Loewen in view of Fujimoto
2	2 and 3	Loewen in view of Fujimoto, Garrot, and Mostafa
3	4 and 26	Loewen in view of Fujimoto and Kain 1997
4	5, 19, 20, and 21	Loewen in view of Fujimoto and Mostafa
5	26	Loewen in view of Fujimoto, Mostafa, and Kain 1997
6	27	Loewen in view of Fujimoto and Kain 2003
7	27	Loewen in view of Fujimoto, Mostafa, and Kain 2003

1. Overview of "Airborne Inventory and Inspection System and Apparatus"—U.S. Patent No. 7,184,072 B1 ("Loewen")

82. Loewen (EX1004) is a U.S. Patent filed September 6, 2002. I understand that Loewen is prior art to the '657 patent. Loewen is entitled "Airborne Inventory and Inspection System and Apparatus" and describes, among other things, "acquiring images of electric transmission line tower structures," including multiple

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cameras, including at least two still cameras "point[ing] rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantial 30–60 degrees to the horizontal." *E.g.*, EX1004 (**Loewen**), Abstract, 2:39-49, 3:51-57, Figs.2, 5-6:



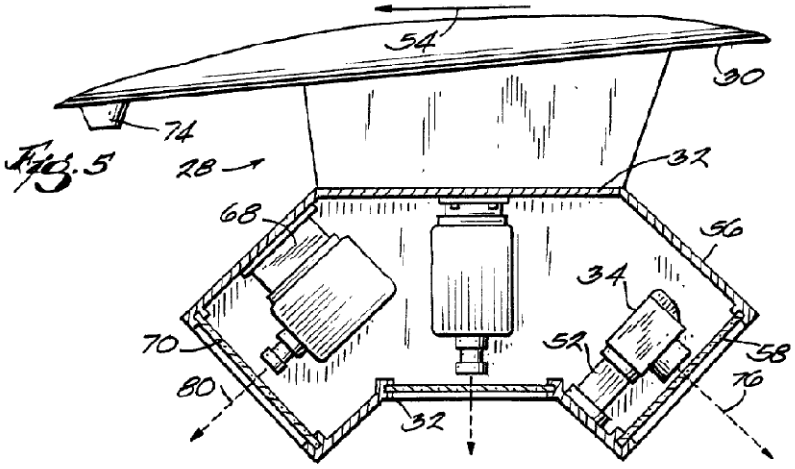


Fig. 5

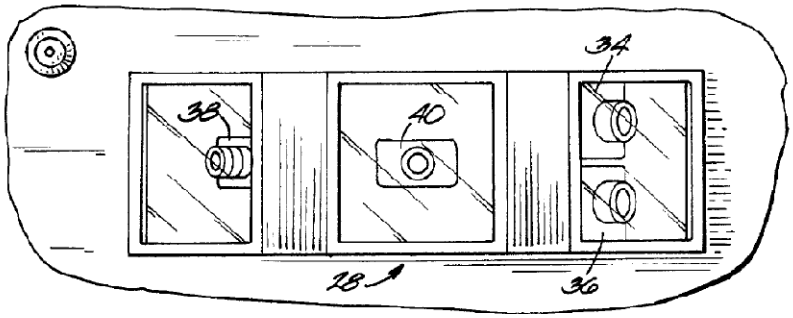


Fig. 6

83. In addition to still cameras, Loewen discloses at least two additional video cameras (EX1004 (**Loewen**), Figs. 5-6), and expressly discloses that "[t]he number and arrangement of the cameras can vary." *E.g.*, EX1004 (**Loewen**), 5:66-67. Loewen discloses "[t]he still camera exposure is automated by… an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras… to automatically active the still cameras at the exposure points along the transmission line." *E.g.*, EX1004 (**Loewen**), 3:4-10. Loewen further discloses its cameras "write their information directly to the onboard computer system." *E.g.*, EX1004 (**Loewen**), 6:49-51, Fig.8:

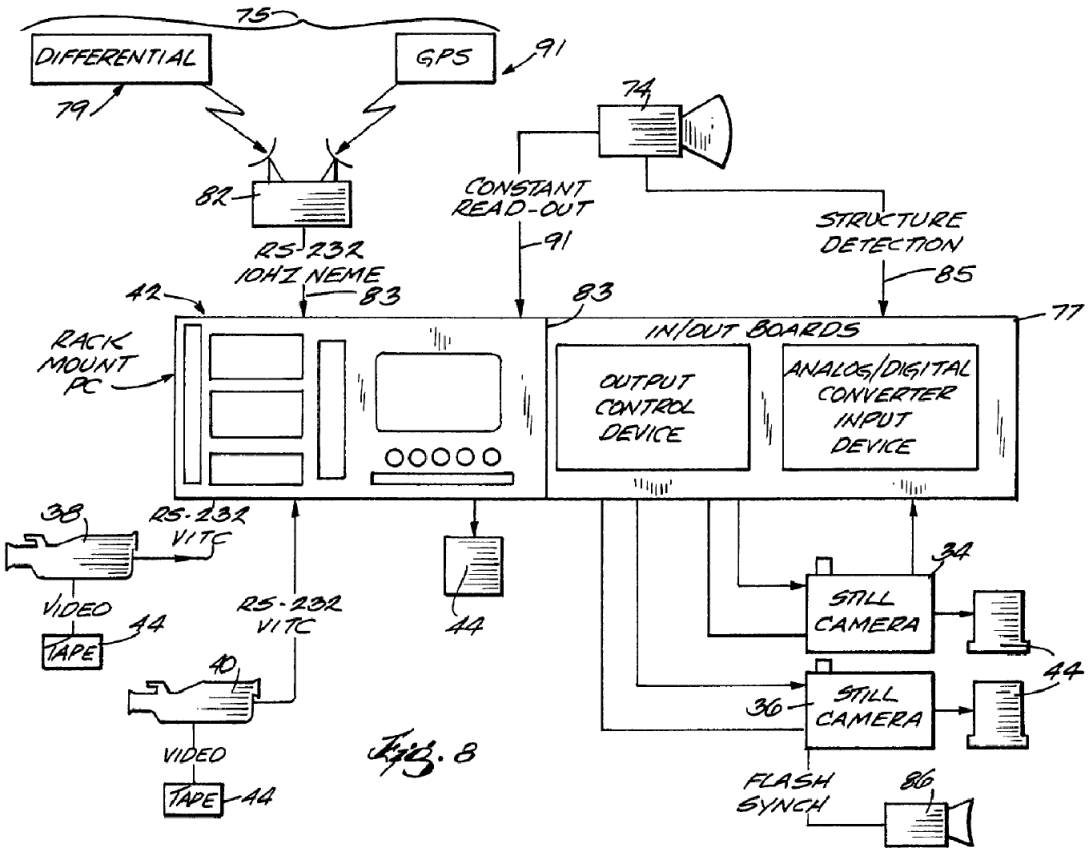


Fig. 8

84. Loewen further discloses its "cameras provide the image-acquiring portion of the overall system" and the "system also includes a geographic positioning system," which, *inter alia*, "in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates," and "that data is transmitted to the onboard computer and… is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower" and "[t]he embedding of a geographical location can be done in association with images captured by both the still and video cameras." *E.g.*, EX1004 (**Loewen**), 3:38-51.

85. For each claim challenged in Grounds 1-7, I rely on Loewen for its teachings relating to all limitations of independent claim 1 except for separate camera control.

2. Overview of "A Computerized Control for Aerial Photography"—European Patent Application No. 0053640 A1 ("Fujimoto")

86. Fujimoto (EX1005) is a European Patent application published June 16, 1982. I understand that Fujimoto is prior art to the '657 patent. Fujimoto is entitled "A Computerized Control for Aerial Photography" and describes, among other things, "***a computerized control for aerial photography*** for use in association with aerial cameras mounted in an aeroplane. The cameras are mounted… and take photographs in succession at different altitudes and speeds along the line of flight under the computerized control." *E.g.*, EX1005 (**Fujimoto**), ¶0001. "The computerized control of the invention can be employed for taking photographs not only vertically but also obliquely to the ground…." *E.g.*, EX1005 (**Fujimoto**), ¶0021, Figs.1, 3:

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FIG. 1

"[T]wo cameras are mounted in the aeroplane, one being with an angle of α while the other being with an angle of β."

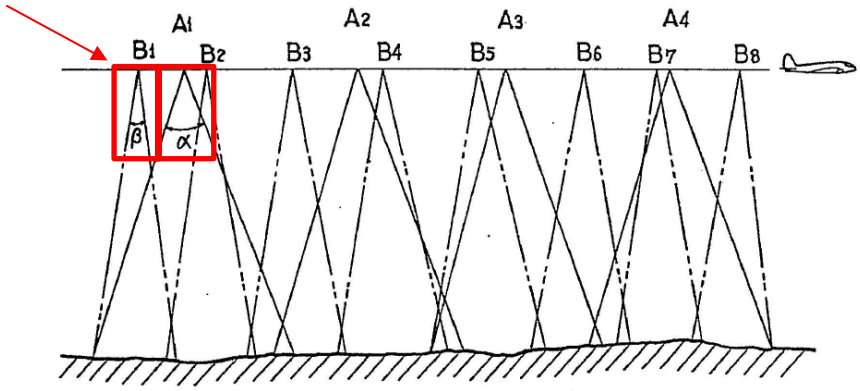
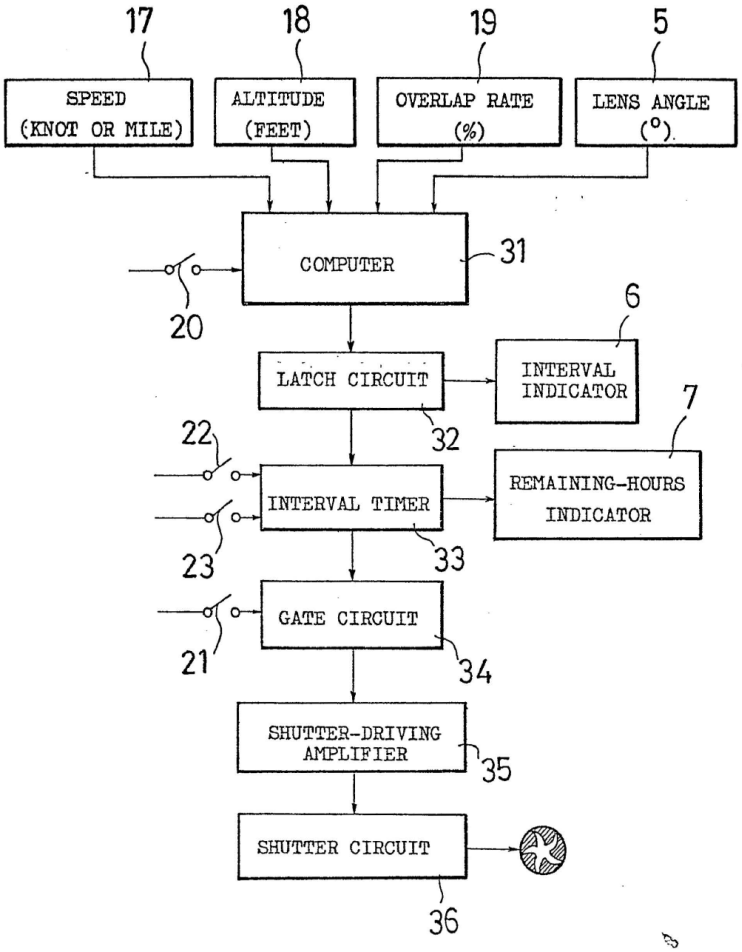
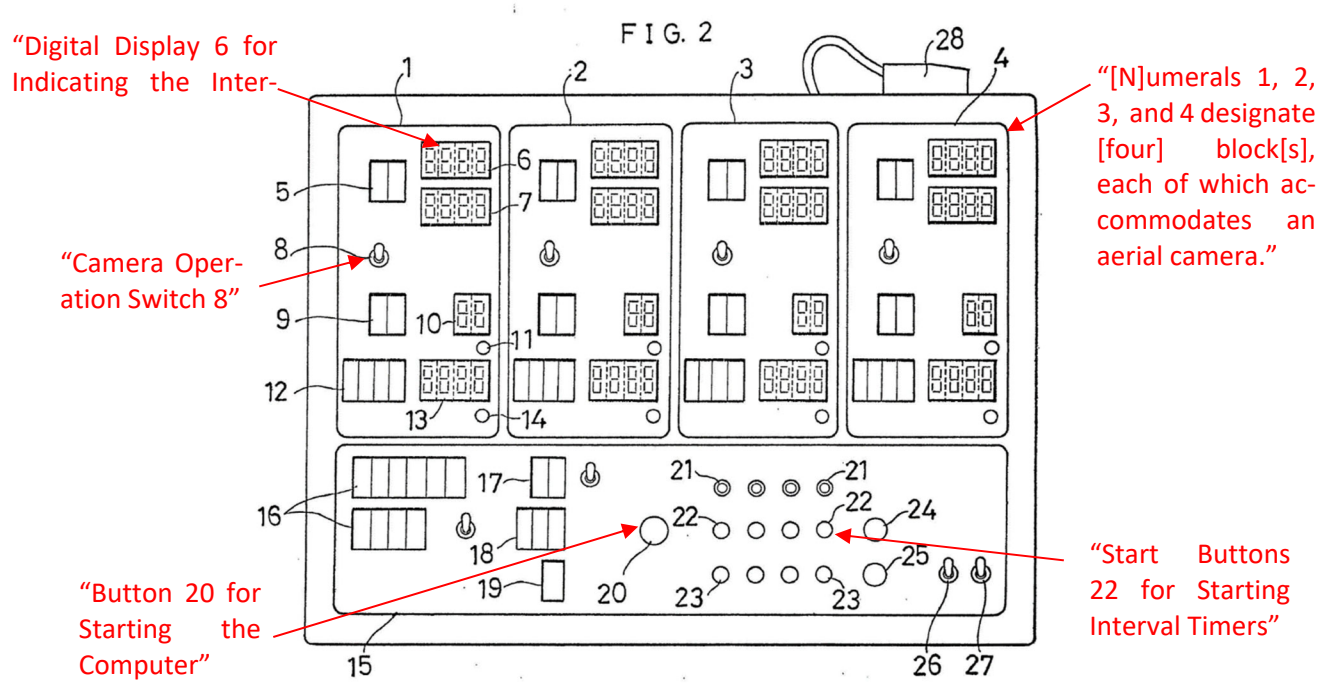


FIG. 3



87. Fujimoto discloses independent camera control, describing, *inter alia*, that its system "provide[s] a computerized control for ***opening the shutters of a plurality of cameras independently of one another*** thereby to secure a series of photographs of the ground without the waste of film." *E.g.*, EX1005 (**Fujimoto**), ¶0004, cl.1 ("thereby ***[e]nabling each shutter to be driven at independently different interval time***"), Fig.2 (showing four "blocks" "each of which accommodates an aerial camera."), ¶0008):



88. Fujimoto further discloses that "various data, such as camera numbers and dates," and "Hour-Minute-Second" from an "Electronic Clock" "is transcribed in the film together with the images of the ground." *E.g.*, EX1005 (**Fujimoto**), ¶¶0005, 0014, Figs.6, 8.

89. For each claim challenged in Grounds 1-7, I rely on Fujimoto for its teachings relating to separate, independent control for each camera as required by independent claim 1.

3. Overview of "Aircraft Based Infrared Mapping System for Earth Based Resources"—U.S. Patent No. 5,878,356 ("Garrot")

90. Garrot (EX1006) is a U.S. Patent that issued on March 2, 1999. I understand Garrot is prior art to the '657 patent. Garrot is entitled "Aircraft Based Infrared Mapping System for Earth Based Resources" and describes, among other things, "[a]n aircraft based imaging system comprising a sensor mounted in the aircraft in a known orientation, circuitry for acquiring signals generated by the sensor… a system for georeferencing the acquired signals; and a system for compensating for tilt in the acquired signals" including a "compass" and "gyroscope." *E.g.*, EX1006 (**Garrot**), 4:66-5:9, 6:14-47, 8:18-60 ("vertical gyro 26 resides on the imaging platform 11 and produces pitch and roll data needed for an accurate projection of each logged image frame"), 12:24-29, 13:45-48, 13:56-59, 19:49-58, Fig.3 ("Airborne Raw Dat[a]" includes "Compass file"), Fig.1:

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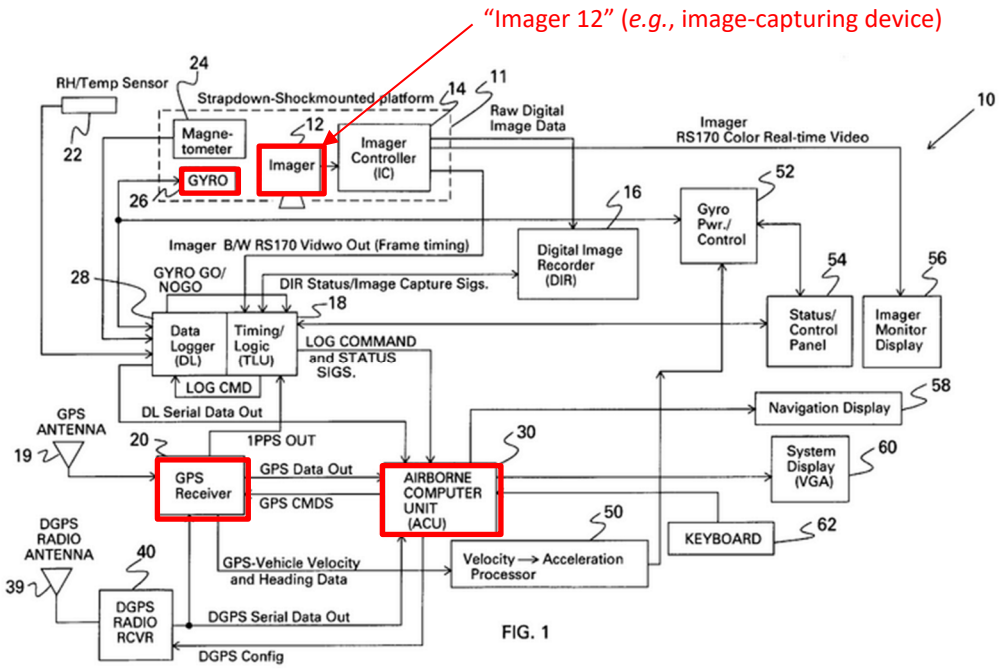


FIG. 1

91. For claims 2 and 3 challenged in Ground 2, I rely on Garrot for its disclosures of a "gyroscope" and a "compass."

4. Overview of "Digital Image Georeferencing from a Multiple Camera System by GPS/INS" ("Mostafa")

92. Mostafa (EX1007) is an article published in June 2001 in a regularly-published journal. I understand that Mostafa is prior art to the '657 patent. Mostafa is entitled "Digital image georeferencing from a multiple camera system by GPS/INS" and describes, among other things, "an airborne fully digital multi-sensor system for digital mapping data acquisition…. The system acquires two streams of data, namely, navigation (georeferencing) data and imaging data." *E.g.*, EX1007 (**Mostafa**), Abstract. Mostafa discloses, *e.g.*, that "imaging data are acquired by two low-cost digital cameras" that "capture strips of overlapping nadir… images," *e.g.*,

EX1007 (**Mostafa**), Abstract, 4 ("image data is collected by two low-cost Kodak DCS420c digital cameras" "one of which is nadir, and the other is oblique"), 12 ("It is therefore, recommended to design an ***industrial computer system*** that can accommodate the necessary boards ***for simultaneous navigation and image data acquisition***."), Fig.6:

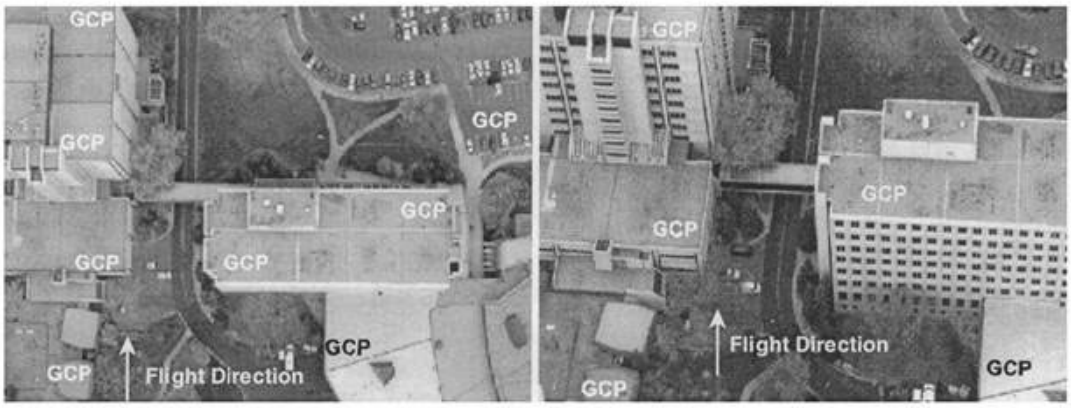


Fig. 6. A nadir digital image (left) and an oblique digital image (right), October 1998 flights.

93. Mostafa further discloses the "navigation data are obtained by integrating an accurate strapdown ***inertial navigation system*** with a differential GPS system (DGPS)…. The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft." *E.g.*, EX1007 (**Mostafa**), Abstract, 2 ("3D vector of coordinates of the exposure station E, of any imaging sensor, at the instant of exposure,"), 4 ("navigation data is collected using a ***Honeywell LRF III inertial navigation system***, and an Ashtech ZXII GPS receiver, connected to a portable computer for raw data acquisition")). Mostafa additionally discloses using "GPS/INS interpolated position and attitude angles at each exposure station…

together with the imagery to analyze the system performance when using nadir… images." EX1007 (**Mostafa**), 9, Fig.8 (inertial navigation system ("INS") and image-capturing devices):

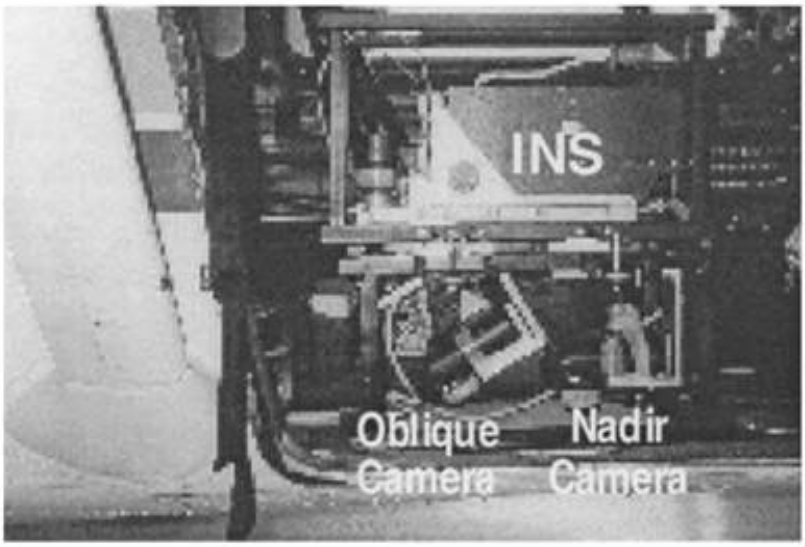


Fig. 8. The multi-sensor system used in the October 1998 test flights.

94. For claims 2, 3, 5, 19-21, and 26-27 challenged in Grounds 2, 4, 5, 6, and 7, I rely on Mostafa for its disclosure of an image-capturing device capturing orthogonal aerial images and an "inertial navigation system."

5. Overview of "Airborne Imaging System"—International Patent Application WO 97/35166 ("Kain 1997")

95. Kain 1997 (EX1008) is an International Patent Application published September 25, 1997. I understand that Kain 1997 is prior art to the '657 patent. Kain 1997 is entitled "Airborne Imaging System" and describes, among other things, a "remote data collection system, which may be used in a vehicle such as an aircraft" and "includes a directional sensor, such as one or more cameras" and "further

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includes a global positioning system (GPS) receiver for providing GPS data representative of the position of the sensor, an inertial measurement unit (IMU) for providing IMU data representative of the attitude of the sensor." *E.g.*, EX1008 (**Kain 1997**), Abstract, 5:32-6:1 ("GPS data accurately represents the position of GPS receiver 46 and therefore represents the position of cameras 20, 22 and 24"). Kain 1997 further discloses "a processing unit and a storage unit" that "determines geographic data referenced to the sensor data in response to the GPS data and IMU data" and "record[s] an image signal and position information on magnetic tape." *E.g.*, EX1008 (**Kain 1997**), Abstract, 2:14-22. Kain also expressly discloses "***one foot per pixel image resolution***" (*i.e.*, a ground sample distance of 1 foot/pixel). EX1008 (**Kain 1997**), 10:11-14.

96. For claims 4 and 26 challenged in Grounds 3 and 5, I rely on Kain 1997 for its disclosure of "one foot per pixel image resolution."

6. Overview of "Digital Imaging System for Airborne Applications"—U.S. Patent Application Publication No. 2003/0048357 ("Kain 2003")

97. Kain 2003 (EX1009) is a U.S. Patent Application Publication published March 13, 2003. I understand that Kain 2003 is prior art to the '657 patent. Kain 2003 is entitled "Digital Imaging System for Airborne Applications" and describes, among other things, "aerial imaging system has an image storage medium locatable in an aircraft," having "multiple cameras," a "global positioning system (GPS)…

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detecting the position of the imaging system and providing a corresponding input to the controller," and an "inertial measurement system (IMU) [] fixed in position relative to the camera assembly" that "detects acceleration and rotation rates of the camera assembly and provides an input signal to the controller." *E.g.*, EX1009 (**Kain 2003**), Abstract, ¶9. "Control of the imaging system is maintained by a controller that is located within the aircraft and to which the camera assembly 12 is electrically connected." *E.g.*, EX1009 (**Kain 2003**), ¶¶23, 31. Further, "the precise attitude and position of the camera assembly is known at the time the cameras are triggered. This information may be correlated with the pixels of the image to allow the absolute coordinates on the image to be determined." *E.g.*, EX1009 (**Kain 2003**), ¶¶26 ("Rather than attempt to keep the camera assembly oriented perpendicularly relative to the ground below, the system uses various sensor data to track the orientation of the camera assembly relative to the camera trigger times"), 34. Kain 2003 thus expressly discloses a ground sample distance ("GSD") of 0.196 ft (2.352 inches/pixel) at 500 ft altitude and 0.391 feet (4.692 inches/pixel) at 1000 ft altitude, along with corresponding image heights and areas. *E.g.*, EX1009 (**Kain 2003**), Table 3.

98. For claim 27 challenged in Grounds 6-7, I rely on Kain 2003 for its disclosure of neighborhood-level imagery.

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7. Loewen, Fujimoto, Garrot, Mostafa, Kain 1997, and Kain 2003 Are Analogous Art

99. In my opinion, each of Loewen, Fujimoto, Garrot, Mostafa, Kain 1997, and Kain 2003 is analogous art to the ’657 patent (and to each other).

100. As discussed (§V.A), ’657 relates to “[a] system for capturing images and geo-location data corresponding thereto.” EX1001 (**’657**), 4:17 (“[i]mage-capturing and geolocating system 30”), cl.1, Figs.1, 2. ’657 also states that it relates to “photogrammetry,” which, according to ’657, “involve[s] coupling the photographs with other data, such as data representative of latitude and longitude.” EX1001 (**’657**), 1:38-40 Like ’657, Loewen, Fujimoto, Garrot, Mostafa, Kain 1997, and Kain 2003 all relate to “photogrammetry” (as used by ’657) and are directed to imaging systems, including aerial imaging systems and computerized control thereof, and geolocating of images (*e.g.*, using latitude and longitude data) taken using those aerial image systems (including oblique images). *E.g.*, EX1004 (**Loewen**), Abstract, 3:38-51, Figs.2, 5-6, 8; EX1005 (**Fujimoto**), ¶¶0001, 0004, 0005, 0014, Figs.1-3, 6, cl.1; EX1006 (**Garrot**), 1:6-9, 5:10-25; EX1007 (**Mostafa**), Abstract, 4, Fig.6, Fig.8; EX1008 (**Kain 1997**), Abstract, 2:14-22; 5:32-6:1; EX1009 (**Kain 2003**), Abstract, ¶¶9, 23, 26, 31, 34. Thus, Loewen, Fujimoto, Garrot, Mostafa, Kain 1997, and Kain 2003 are analogous art to ’657 (and each other)

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because they are in the same field—and only Loewen and Kain 1997 (cited as U.S. Patent 5,894,323) were before the Examiner during prosecution.

101. Additionally, each of Loewen, Fujimoto, Garrot, Mostafa, Kain 1997, and Kain 2003 are analogous to '657 because each is also reasonably pertinent to the problem faced by the '657 patent's named inventors. The '657 patent described this problem as a "need[] in the art" for "a method and apparatus for photogrammetry that enables geo-location and accurate measurements within oblique images," and "a method and apparatus for photogrammetry that utilizes more intuitive and natural images," explaining "[p]hotogrammetry may also involve ***coupling the photographs with other data, such as data representative of latitude and longitude***." EX1001 (**'657**), 1:38-40, 2:62-63, 3:1-3. Each asserted reference likewise relates to this solution of photogrammetry:

102. Loewen discloses "provid[ing] reliable and accurate images of the tower structures of an electric transmission line and related equipment" and "provid[ing] aerial images of ground structures, apparatus, and roadways… in an accurate, reliable, and cost-effective manner," together with obtaining "a record of the respective locations of the power line towers" and other structures, including by associating geo-location information with each image (including oblique images). *E.g.*, EX1004 (**Loewen**), 1:16-20, 2:11-26, 2:30-36.

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103. Fujimoto discloses computerized, independent camera control "applicable in surveying the land," and "making maps" to allow its cameras, which are "employed for taking photographs not only vertically but also obliquely to the ground," to "secure a series of photographs of the ground without waste of film," and to transcribe in those images "camera numbers and dates," and other information (*e.g.*, time), thus creating more intuitive and useful images by, *e.g.*, including geo-location information with each image, including oblique images. *E.g.*, EX1005 (**Fujimoto**), ¶¶0001, 0004, 0005, Fig.6.

104. Garrot similarly observes that "[c]onventional aircraft based infrared imaging systems have a limiting mapping capability" and their "images are taken are ***not georeferenced or corrected for tilt***," and thus "do not generate large accurate maps at a high level of resolution on a repeatable basis." *E.g.*, EX1006 (**Garrot**), 4:34-56. Garrot states it addresses these problems, and in doing so increases the intuitiveness and usefulness of captured imagery. *E.g.*, EX1006 (**Garrot**), 4:59-65.

105. Mostafa, which relates to "digital photogrammetry," discloses "development and testing of an airborne fully digital multi-sensor system for ***digital mapping data***," which acquires "nadir… images" and obtains geo-location data, including "GPS/INS-derived trajectory [that] contains the full translational and rotational motion of the carrier aircraft," for association with captured imagery (*e.g.*, "data logging software which downloads the GPS/INS/imagery data… and time tags

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the imagery and INS records by the GPS receiver-derived time pulse") thus "eliminat[ing] the need for ground control (GCP) when computing 3D positions of objects that appear in the field of view of the system imaging component" (*e.g.*, EX1007 (**Mostafa**), Abstract, 1, 4), thereby increasing the intuitiveness of captured imagery.

106. Kain 1997 observes that the "cost of data and the response times for obtaining data has limited the broad applicability for use in day-to-day business operations," and that prior solutions often did not provide sufficient imagery. *E.g.*, EX1008 (**Kain 1997**), 1:9-11, 2:5-8. Kain 1997 thus discloses a system to address such issues, including "image data [that] can immediately be registered because position coordinates for each image pixel are known," such that "[m]aps showing roads, cultural features, hydrology and the like can easily be overlaid on the image," thus increasing the intuitiveness of imagery. *E.g.*, EX1008 (**Kain 1997**), 8:6-9 ("without risking loss of coverage between images in adjacent passes"), 13:6-15.

107. Kain 2003 observes that, "[t]raditionally, the mounting of airborne cameras has required special aircraft modifications," but, "[r]ather than attempt to keep the camera assembly oriented perpendicularly relative to the ground below, [its] system uses various sensor data to track the orientation of the camera assembly relative to the camera trigger times." *E.g.*, EX1009 (**Kain 2003**), ¶¶6, 26. As Kain 2003 explains, "[t]his allows each pixel of each camera to be ray-traced onto a

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'digital elevation model'" which, allows for the "creation of a composite mosaic image formed from all geo-registered frames," *E.g.*, EX1009 (**Kain 2003**), ¶26, thus increasing the intuitiveness and naturalness of captured imagery.

108. In my opinion, Loewen, Fujimoto, Garrot, Mostafa, Kain 1997, and Kain 2003 are thus reasonably pertinent to the problem faced by the '657 patent's named inventors.

109. Thus, for these reasons, it is my opinion that these references are all analogous to the '657 patent and to one another.

* * *

110. For ease of presentation, in the following section, I discuss each of the Challenged Claims, beginning first with Claim 1, followed by Claims 3, 2, 4, 5, 14, 19, 20, 21, 26, and 27, in that order. I note that the arguments and evidence provided for Claim 1 include the arguments and evidence establishing that Claims 2, 3, 4, 5, 14, 19, 20, 21, 26, and 27 are also unpatentable as obvious.

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C. Claim 1 Is Rendered Obvious Over Loewen in View of Fujimoto (Ground 1)

111. **In my opinion, Claim 1 is rendered obvious over Loewen in view of Fujimoto.** *See infra*, Appendix C, Claim 1.[2]

1. Element 1.pre (the preamble of claim 1)[3]

112. Claim 1.pre recites "A system for capturing images and geo-location data corresponding thereto, comprising." **In my opinion, Loewen discloses this limitation.**

113. In my opinion, **Loewen discloses a system for capturing images** (*e.g.*, "system… for acquiring images of electric transmission line tower structures, equipment…, and transmission lines"; "airborne inventory and inspection system designed to obtain high resolution images… with a record of the respective location of the power line towers") **and geo-location data corresponding thereto** (*e.g.*, "laser altimeter or… GPS unit… supplies continuous longitude/latitude coordinates for the aircraft location"; "GPS… continuously provides the position of the aircraft in longitude and latitude coordinates… [and] is embedded in the collected data in

[2] As discussed below, this mapping for Ground 1 is also applicable to the dependent claims addressed in Grounds 2-7.

[3] To the extent deemed limiting, the preamble is disclosed.

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association with the image… recording… longitude/latitude coordinates in association with the image"; "height of the aircraft")**.**

114. For example, Loewen expressly discloses a **system for capturing ("acquiring") aerial images and corresponding geo-location data**, including longitude/latitude coordinates from a GPS: "**A system… for acquiring images of electric transmission line tower structures… uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software.**…. **The detection means is a laser altimeter or[4] a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates**." *E.g.*, EX1004 (**Loewen**), Abstract; *see also, e.g.*, EX1004 (**Loewen**), cl.1 ("**A system for acquiring images** of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said system utilizing an aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software and

[4] *See* ¶238.

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connected to said cameras, said means for detecting a tower structure, and said storage unit, said system comprising the steps of:….").

115. Loewen similarly explains that its system obtains "high resolution images" of, *e.g.*, "electric transmission power lines" and "support structure towers" and creates a "record" of locations of the power line towers: "**This invention relates to an airborne inventory and inspection system designed to obtain high resolution images of electric transmission power lines, the power line right-of-way and the support structure towers, along with a record of the respective location of the power line towers**, which system is an improvement over current accepted systems and can be performed at a cost that makes use of this system more cost effective than alternatives available to the electrical power transmission industry." *E.g.*, EX1004 (**Loewen**), 1:16-24; *see also, e.g.*, EX1004 (**Loewen**), 2:22-25 ("It is among the objectives of this invention to provide aerial images of ground structures, apparatus, roadways and the like in an accurate, reliable and cost-effective manner."), 9:6-13 ("**The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude. With the appropriate software programming as mentioned above, the system is capable of embedding the longitude/latitude coordinates for** either the video output or **the still camera output.** That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association with the image of a particular

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tower."), 3:37-50 ("**The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates**" and that "**data is transmitted to the onboard computer and,** … **is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower.** This **recording of the tower location in longitude/latitude coordinates in association with the image of each tower** provides an inventory database of all of the towers along a particular transmission line. The embedding of geographical location can be done in association with images captured by both the still and video cameras."), 8:15-34 ("the laser altimeter by projecting a laser beam 87 downwardly to the terrain, is capable of determining the height of the aircraft above the terrain").

116. Lowen explains that to do so, it uses one or more still cameras in different orientations, explaining, *inter alia*, that "the digital still cameras can be oriented such that they would both take a landscape type photograph or one would capture a landscape photograph whereas the other camera would produce a portrait photograph." *E.g.*, EX1004 (**Loewen**), 11:36-40; *see also, e.g.*, EX1004 (**Loewen**), Figs.5-6:

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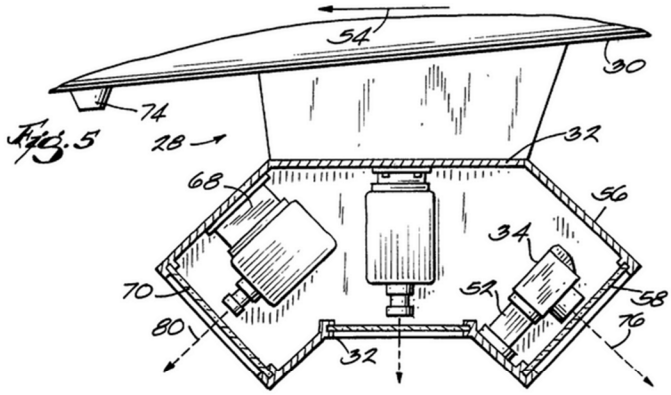


Fig. 5

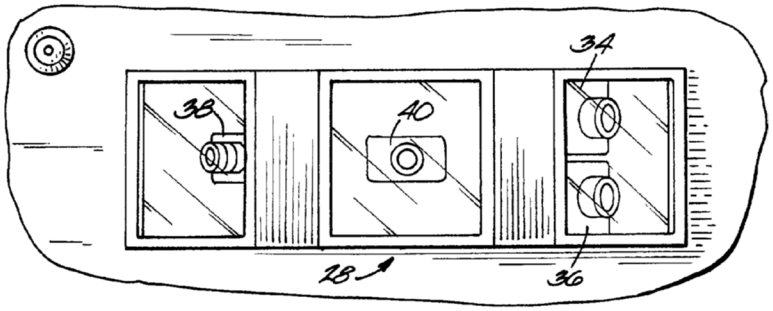


Fig. 6

117. Loewen further discloses a "data collection system" that collects, *e.g.*, image data: "**A fixed wing aircraft 26 is equipped with a data collection system.**" *E.g.*, EX1004 (**Loewen**), 5:43-44. For example, "the fixed wing aircraft is a Piper Pawnee of the type commonly used in crop dusting applications. The data collection system includes a pod 28 fixed to the underside 31 of the aircraft fuselage generally in the area which would coincide with the center of gravity of the aircraft. Locating the pod in the area of the center of gravity minimizes the error in the data collection system that can occur due to movement of the aircraft from the preferred line of flight, as will be described and/or become evident from the description to follow." *E.g.*, EX1004 (**Loewen**), 5:44-53, Figs.1-2, 8:

Fig. 1

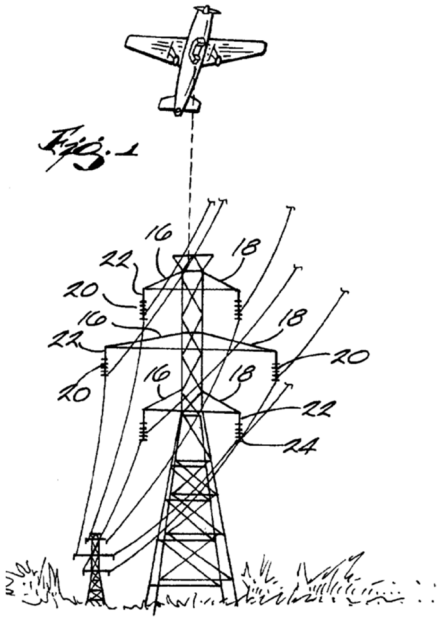
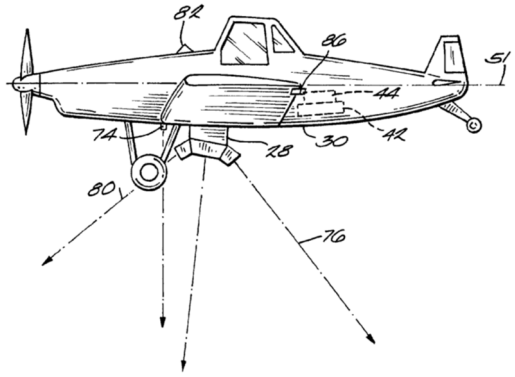


Fig. 2



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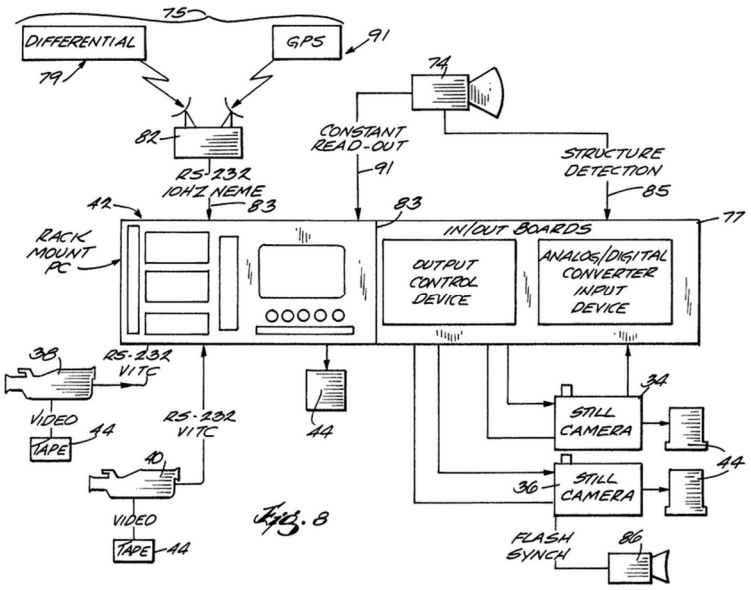


Fig. 8

* * *

118. Thus, in my opinion, Loewen discloses this limitation.

2. Element 1.a

119. Claim 1.a recites "**a first image-capturing device, said first image-capturing device capturing oblique aerial images at image-capturing events, said first image-capturing device issuing first image-data signals corresponding to captured images.**" **In my opinion, Loewen discloses or renders obvious this limitation.**

120. In my opinion, **Loewen discloses a first image-capturing device** (*e.g.*, "still camera" (*e.g.*, Fig. 1 ("still camera[] 34"))**, said first image-capturing device capturing oblique aerial images** (*e.g.*, conventional "still camera[] point[s] rearwardly relative to the line of flight of the aircraft and take[s] a picture from between two adjacent towers and along an exposure line directed downwardly at an

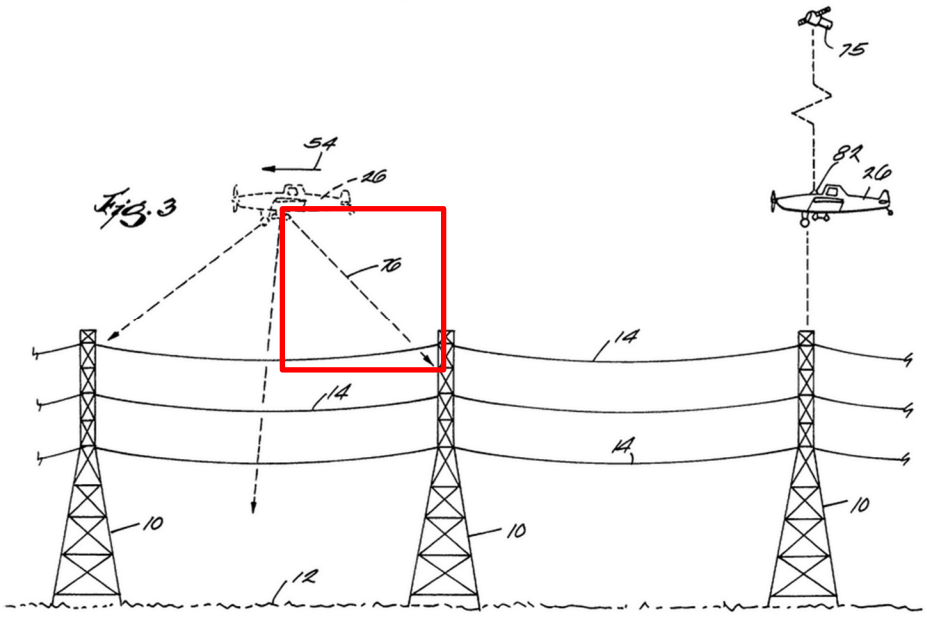
angle to the line of flight, 30–60 degrees and preferably 45 degrees"; "still cameras… arranged to take pictures along a line 76 at an angle to the line of flight… in the range of 30–60 degrees, preferably 45 degrees"; Figs.2-3, 5) **at image-capturing events** (*e.g.*, event in which "still camera is activated at the exposure point to acquire an image"; "still camera" "trigger[ed]… to acquire the images"; "computer… perform[s] real time coordination of camera tripping"; "still cameras" "automatically activate[d]… at the exposure points along the transmission line"; "cameras… trigger[ed] based on actual detection of the presence of the tower structure")**, said first image-capturing device issuing first image-data signals corresponding to captured images;** (*e.g.*, "cameras… write their information directly to the onboard computer"; "data corresponding to the [camera's] acquired image is transmitted to a data storage unit"; "data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft")**.**

121. First, in my opinion, Loewen discloses a **first image capturing device capturing oblique aerial images at image-capturing events** as required by the claim.

122. For example, Loewen expressly discloses that its system includes a "still camera" that "points rearwardly… at an angle to the line of flight, 30–60 degrees": "A system and apparatus for acquiring images …. **The system uses a fixed wing aircraft and an arrangement of at least one still camera**…. **The still**

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camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees.…." *E.g.*, EX1004 (**Loewen**), Abstract. Loewen similarly discloses "[t]**he still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees.**" *E.g.*, EX1004 (**Loewen**), 2:39-49. *See also* EX1004 (**Loewen**), 7:62-8:7 ("still cameras are arranged to take pictures along a line 76 at an angle to the line of flight. That angle is in the range of 30–60 degrees, preferably 45 degrees"); 11:41-51, 6:31-58, 5:62-6:2, Figs.3, 5, 6, 8:



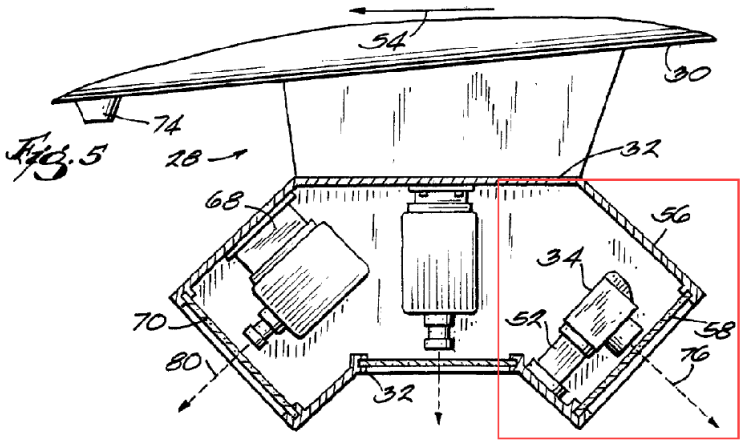


Fig. 5

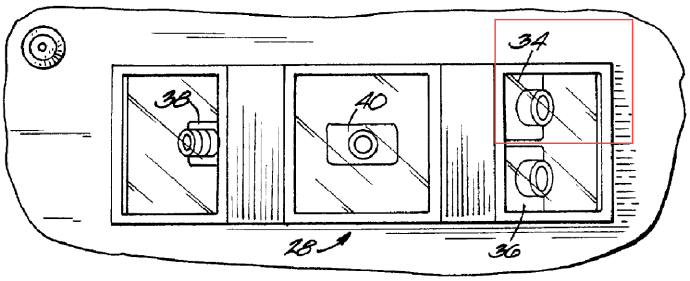


Fig. 6

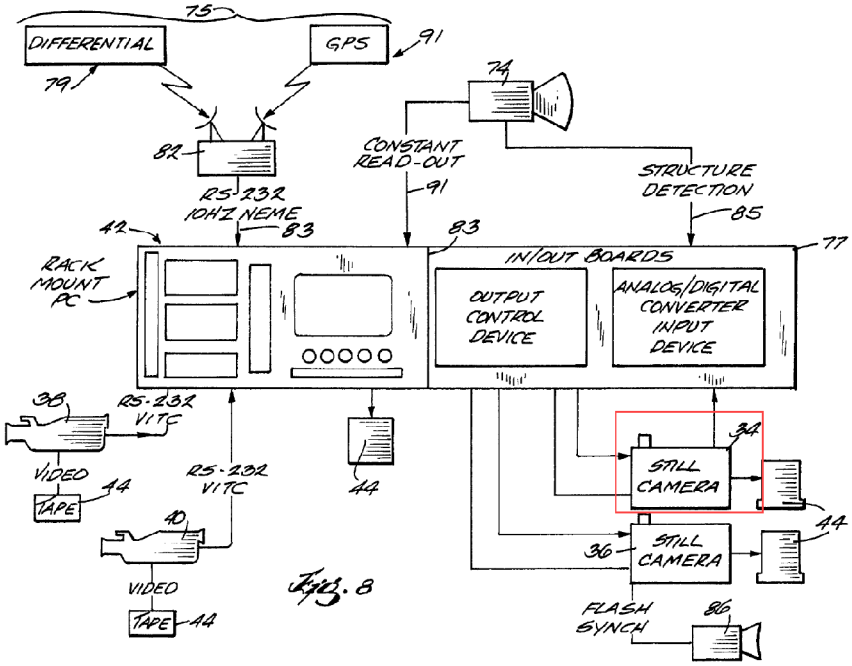


Fig. 8

123. As discussed (*see* §V.C), I have been asked to assume that "oblique aerial images" means "an aerial image capturing a generally trapezoidal area or view of the subject surface or object, with the foreground of the trapezoid having a substantially smaller ground sample distance (i.e., a higher resolution) than the background of the trapezoid." The '657 patent provides exemplar oblique aerial images, explaining, *e.g.*, that "[f]or oblique, community-level images, the ground sample distance varies from, for example, approximately one-foot per pixel in the foreground of the image to approximately two-feet per pixel in the mid-ground of the image, and to approximately four-feet per pixel in the background of the image" (*i.e.*, a ground sample distance in the background of the image that is approximately 4 times the ground sample distance in the foreground). EX1001 (**'657**), 13:55-60. The '657 patent also explains that "[o]blique neighborhood-level image have a ground sample distance of, for example, from approximately four-inches per pixel in the foreground of the image to approximately six-inches per pixel in the mid-ground of the image, and to approximately ten-inches per pixel in the background of the image" (*i.e.*, a ground sample distance in the background of the image that is approximately 1.67 times the ground sample distance in the foreground). EX1001 (**'657**), 14:4-9.

124. Aerial imagery meeting the '657 patent's definition of "oblique aerial images" and having the above-discussed exemplary background to foreground

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ground sample distance ratios has long been known, as has the ability to select basic camera parameters such as the camera angle and "field of view," in order to obtain aerial imagery having properties POSITA would have found beneficial for a particular desired use. For example, as of at least 1960, POSITA wishing to increase the ground area covered during an aerial survey would have been well aware of how to select a camera angle and to select a lens to increase the camera's field of view (which is the viewable area that can be imaged by a camera's lens system), which would in turn have increased the ground area covered during a survey. This is shown by the below aerial image of Tampa, Florida, which, consistent with '657's example of an "oblique" image, has a ground sample distance in the background of the image that is approximately 1.85 times the ground sample distance in the foreground, as seen in the photo below with annotations I have added using Adobe Illustrator. As my annotations show, *the same straight roadway* measures 6.7pt (a unit of measurement in Adobe Illustrator) in the background of the image as compared to 12.4 pt in the foreground, showing that about 1.85 times as many pixels correspond to the same width of road in the foreground of the image as compared to the background (meaning each pixel in the background of the image covers about 1.85 times as much ground area as each pixel in the foreground of the image), and thus have a ground sample distance that is about 1.85 times that of the pixels in the

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foreground, confirming this as an oblique aerial image as defined in the '657 patent.[5] EX1019, 1:[6]

[5] Of course, these would also be oblique aerial images under Patent Owner's broader definition, as they were taken at an angle.

[6] EX1019 is a compilation of images (taken December 17, 1958, and March 24, 1959, respectively, as shown by clicking the icons for those photographs on interactive the map at the URL below) that I retrieved (and annotated) for illustrative purposes from Oblique Aerials Browser, "A collection of historical aerial photographs of the City of Tampa," https://storymaps.arcgis.com/stories/f26b7c047dde45d6ae2224208d46071a, which states that "[f]rom 1957 to 1960, a series of approximately 200 aerial photographs were made of the City of Tampa," and that these photos "were taken almost entirely at angles between 30 and 45 degrees" and that "most of the aerial photographs were taken only a few hundred feet above the rooftop by airplane." EX1021, 1, 3.

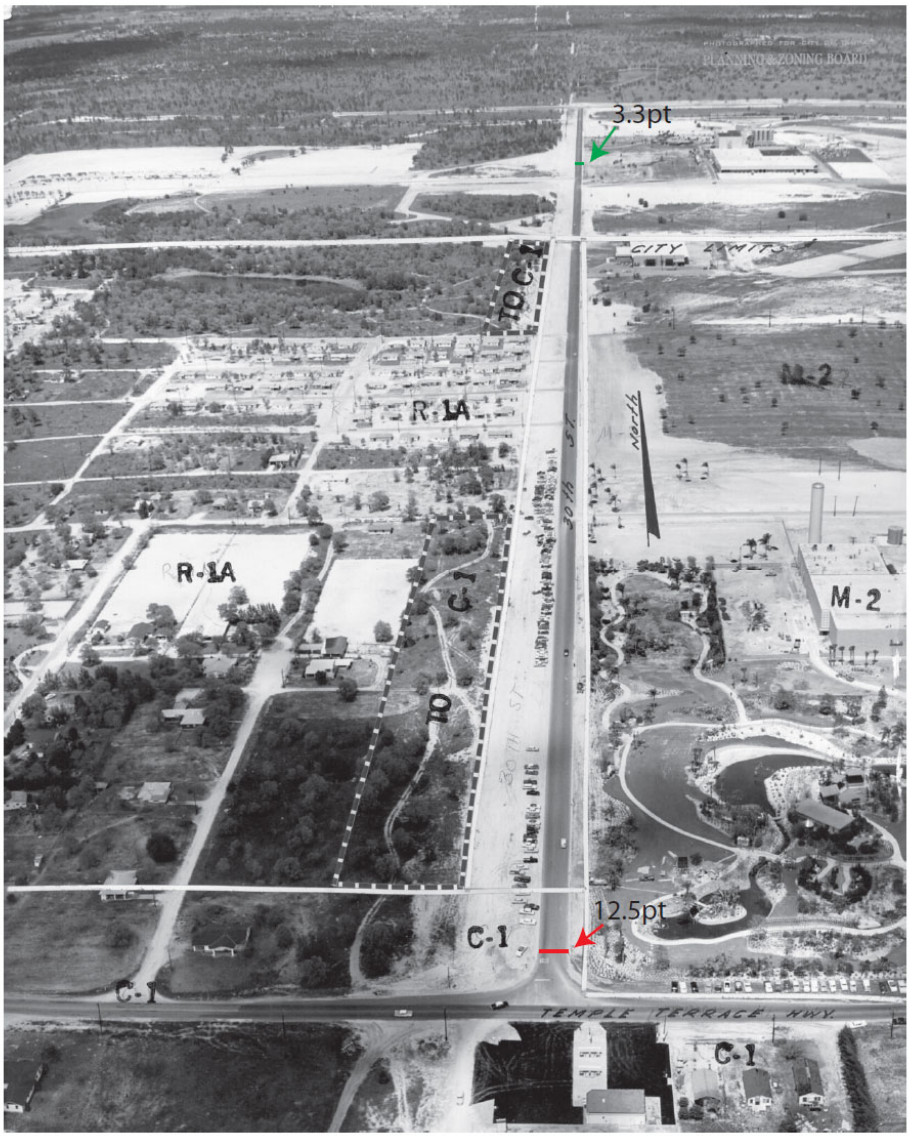
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125. POSITA would have understood that such oblique imagery, as illustrated in this photograph, would have been useful to, *e.g.*, capture images of the layouts of roads or other structures (such as power transmission towers) or obtain views of larger portions of the right-of-way between power transmission towers as described in Loewen than would have been possible using smaller fields of view at the same camera angle, and that using this larger field of view (yielding an oblique aerial image) would have been beneficial because it would have allowed for the capture of the entire area of interest, *e.g.*, using fewer photographs than would have been the case if a smaller field of view were used.

126. Similarly, imagery like the example below taken at an angle and showing (as I have annotated) pixels with a ground sample distance of about 3.78 times larger in the background of the image than in the foreground (*e.g.*, 12.5 pt in the foreground vs. 3.3 pt in the background) were also long known (at least as of 1960), and would also qualify as oblique aerial image as defined in the '657 patent. POSITA would have understood that such imagery—which would have been obtained by selecting camera parameters that yield an even greater field of view than the image above—would have been useful, *e.g.*, to capture even more area, particularly where greater coverage but less detail in portions of the image was required, such as to inspect a larger portion of the right-of-way than would be shown in a photo such as the above to look for, *e.g.*, power transmission structures that have been downed after a severe storm, or larger obstructions in the right-of-way, as described, *e.g.*, in Loewen. EX1019, 2:

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127. In my opinion, Loewen expressly discloses "oblique aerial images" under the above-discussed construction that I have been asked to assume. Loewen discloses its system as, *e.g.*, solving the problem of "inspect[ing] both the right-of-way for electrical transmission lines and the tower structures and related equipment supporting the transmission lines along the right-of-way," including "to detect problems in the right-of-way and defects in the equipment supported on the towers…

and the lines themselves at the tower structure." EX1004 (**Loewen**), 1:28-53, 5:7-24 ("Electrical power is conveyed over transmission lines between power generating plants, field stations, states and the like. In their most basic configuration, these systems include towers 10, which in major part are uniformly spaced along the terrain 12 a desired distance, for example, two-tenths of a mile apart. Transmission cables or lines 14 are strung between the towers and suspended above the terrain."), 5:33-42 ("It is also required to inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees and other plant growth or the like have encroached into the right-of-way"). POSITA wishing to obtain aerial images of, *e.g.*, towers and long stretches of power transmission lines and/or right-of-way for this purpose (*e.g.*, to look for downed wires or other damage following a severe storm, to look for large obstructions in the right-of-way, etc.) as Loewen describes would have readily understood Loewen discloses implementing its system using Loewen's expressly-disclosed parameters along with additional conventional camera parameters well-known to POSITA (such as field of view) to provide such views as Loewen here contemplates. For this purpose disclosed by Loewen, starting with, *e.g.*, Loewen's expressly-preferred 45 degree still camera angle (*e.g.*, EX1004 (**Loewen**), Abstract, 2:46-49 (expressly disclosing still cameras "at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees"), cl.10), POSITA would understood Loewen to disclose using a relatively large field of view

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(*i.e.*, at the higher end of the conventional and well-known range of fields of view[7]) to capture towers and long stretches of power transmission lines and/or an extended view of the right-of-way as Loewen discloses, yielding an oblique aerial image as defined in the '657 patent. For example, implementing Loewen's preferred 45 degree camera angle with a 60 degree field of view (which was conventional and well-known), yields a ground sample distance in the background of the image that is approximately 3.73 times that of the foreground.[8] POSITA would thus have understood Loewen, in describing this camera angle and application, to disclose using a relatively large field of view yielding an oblique aerial image.

128. Thus, in my opinion, Loewen expressly discloses "oblique aerial images."

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[7] POSITA would have understood conventional and well-known fields of view to include, *e.g.*, from "10° to 90°"—as expressly disclosed by, *inter alia*, Fujimoto. *E.g.*, EX1005 (**Fujimoto**), ¶0011 (disclosing "lens angles" (*i.e.*, fields of view) from "10° to 90°"), Fig. 1.

[8] This is calculated using the formula $(\cos(\theta - \Phi/2))/(\cos(\theta + \Phi/2))$, where θ is the camera angle and Φ is the field of view.

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129. To the extent it is argued that further disclosure of Loewen's system capturing "oblique aerial images" using one or more of Loewen's image-capturing devices is required, for these same reasons POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed angled still camera using a relatively large field of view (*i.e.*, at the higher end of the conventional and well-known range of fields of view) yielding an oblique aerial image as defined in the '657 patent, to capture towers and long stretches of power transmission lines and/or an extended view of the right-of-way and beneficially achieve the above-discussed objectives. POSITA would have recognized that increasing the field of view would have advantageously permitted the user of Loewen's system to increase the area of ground visible in each of Loewen's captured images, as appropriate to the specific application (*e.g.*, capture of a larger area of ground, where more context for captured images is required). For POSITA, this would have been an obvious, routine implementation choice, and clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

130. To the extent the construction I have been asked to assume for "oblique aerial images" is not adopted and Patent Owner's broader construction of oblique aerial image as including any image taken in which the image-capturing device is aimed or pointed generally to the side of and downward from the platform that

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carries the image-capturing device is adopted, in my opinion, "oblique aerial images" is expressly disclosed by the above-discussed Loewen disclosures because Loewen expressly discloses multiple still cameras taking images at an angle, *e.g.*, EX1004 (**Loewen**), 2:46-49, which satisfies this broader construction.

131. Second, in my opinion, Loewen discloses that its image-capturing devices (*e.g.*, "still cameras") capture images at **image-capturing events** (*e.g.*, occurrences of "exposure points"): "The still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device. **The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line.**" *E.g.*, EX1004 (**Loewen**), 3:3-10, Abstract ("still camera is activated at the exposure point to acquire an image"), 7:13-31 ("triggering the still cameras to acquire the images of the tower structure, and related support equipment"), 7:49-54 ("computer is then able to perform real time coordination of camera tripping"), 6:31-58 ("To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters…."), 11:15-18 ("the cameras are enabled to trigger based on actual detection of the presence of the tower structure is preferred as it is more consistent and reliable in operation").

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132. Third, in my opinion, Loewen expressly discloses that its first image-capturing device **issues image-data signals corresponding to its captured images**: For example, Loewen discloses that its "cameras… write their information directly to the onboard computer." *E.g.*, EX1004 (**Loewen**), 6:31-58; *see also, e.g.*, EX1004 (**Loewen**), 4:31-34 ("The data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft where it is stored for later retrieval and post processing as desired." *E.g.*, EX1004 (**Loewen**), 4:31-34; *see also, e.g.*, EX1004 (**Loewen**), Abstract ("The **data corresponding to the acquired image is transmitted to a data storage unit** for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower….").

* * *

133. Thus, in my opinion, Loewen discloses or at minimum renders obvious this limitation.

3. Element 1.b

134. Claim 1.b recites "**a second image-capturing device, said second image-capturing device capturing images at image-capturing events, said second image capturing device issuing second image-data signals corresponding to captured images.**" **In my opinion, Loewen discloses this limitation.**

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135. In my opinion, **Loewen discloses a second image-capturing device** (*e.g.*, second "still camera[]" (*e.g.*, Fig.6 ("still camera[] 36")); any additional still camera (*e.g.*, "more still cameras"))**, said second image-capturing device capturing images at image-capturing events** (*see* cl.1.a)**, said second image capturing device issuing second image-data signals corresponding to captured images** (*see* cl.1.a).

136. For example, Loewen expressly discloses **a second image-capturing device** because it discloses multiple "still cameras," including a second "still camera," and explains that its system includes "the use of one ***or more*** still cameras": "[T]his invention proposes a system utilizing a fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images of the electric transmission line tower structures and equipment attached to those towers. **Although this discussion will refer to the use of plural cameras, it will be appreciated that this invention contemplates the use of one or more still cameras.**"[9] *E.g.*, EX1004 (**Loewen**),

[9] I note that POSITA would have understood Loewen's reference to "one or more still cameras" (*e.g.*, EX1004 (**Loewen**), 2:36-38)—instead of "one or two still cameras"—to be an explicit disclosure of at least three still cameras. In the alternative,

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2:30-38. Loewen further provides an illustration disclosing, *e.g.*, two still cameras (*e.g.*, "digital still cameras 34 [mapped above as the first still camera] and 36 [a second still camera]"), and explains that "the number and arrangement of the cameras can vary": "The data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures, the equipment supported on the tower structures and the transmission cables themselves, as well as images of the right-of-way. **The number and arrangement of the cameras can vary, but preferably two digital still cameras 34 and 36** and two digital video cameras 38 and 40 **are mounted within the housing.**" *E.g.*, EX1004 (**Loewen**), 5:62-6:2; *see also, e.g.*, *id.*, Abstract ("still camera").

137. Loewen further discloses an exemplary arrangement of its multiple still cameras (including, for example, its second camera), explaining that in one

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POSITA would at minimum have found it obvious to implement Loewen's teachings using three still cameras (instead of, e.g., two still cameras and a video camera), and in light of Loewen's express disclosures (e.g., of "one or more still cameras (e.g., EX1004 (**Loewen**), 2:36-38)). I rely below on Loewen's disclosure of three still cameras for claims 20, 21, 26, and 27. *See* cl.20, cl.21, cl.26, cl.27. As discussed immediately above, Loewen discloses or at minimum renders obvious three still cameras.

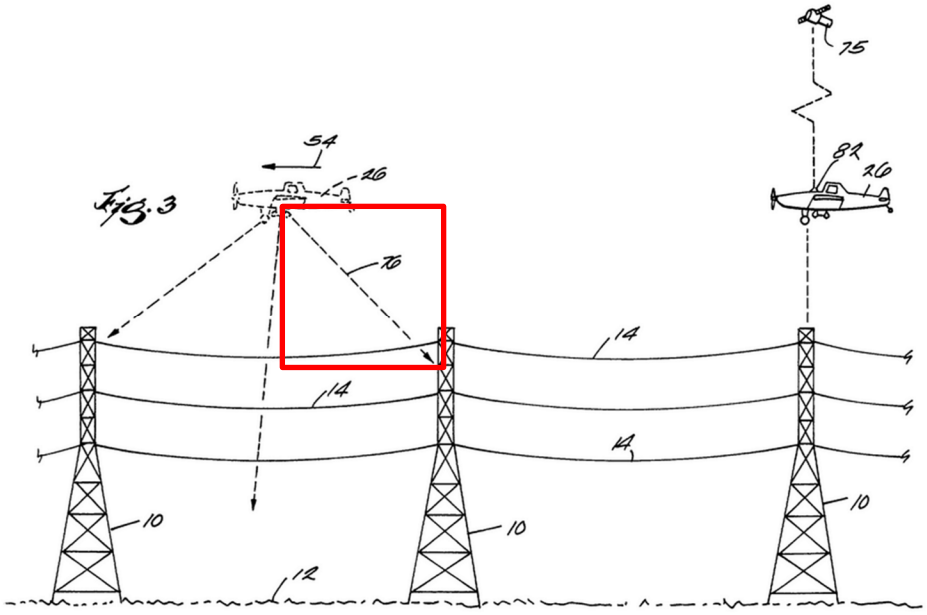
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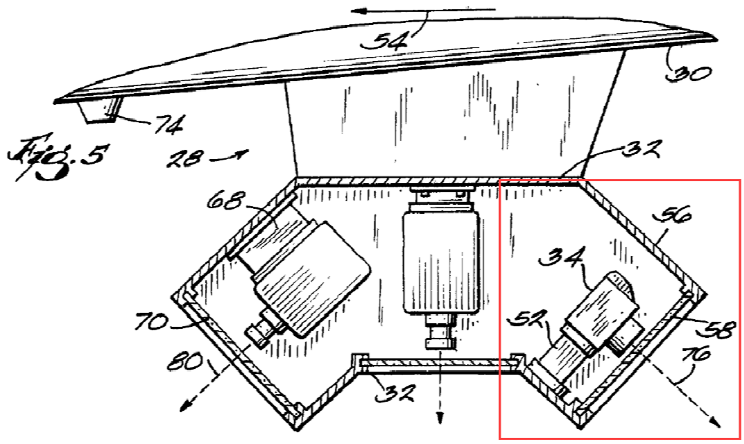
arrangement the still cameras are both rear-facing and are arranged at angle of 30-60 degrees to the line of flight of Loewen's aircraft: "[u]sing the line of flight of the aircraft 54 as a base of reference, a reference base which corresponds generally with the longitudinal axis of the aircraft, **the still cameras are arranged to take pictures along a line 76 at an angle to the line of flight**. That angle is in the range of 30–60 degrees, preferably 45 degrees. Since the aircraft will make its fly over in a horizontal flight altitude, this direction or line of flight will be referred to as horizontal and the angle of the camera orientation will be referred to as being at an angle to the horizontal. It being noted, in that altitude the axis 51 of the aircraft is normally horizontal and the camera exposure angles could also be described in reference to the longitudinal axis of the aircraft." *E.g.*, EX1004 (**Loewen**), 7:62-8:7;[10] *see also, e.g.*, EX1004 (**Loewen**), 11:41-51 ((**"The exposure point for the still cameras is illustrated by the dotted line showing of the aircraft in FIG. 3. The exposure point is horizontally between two adjacent towers 10 and the still**

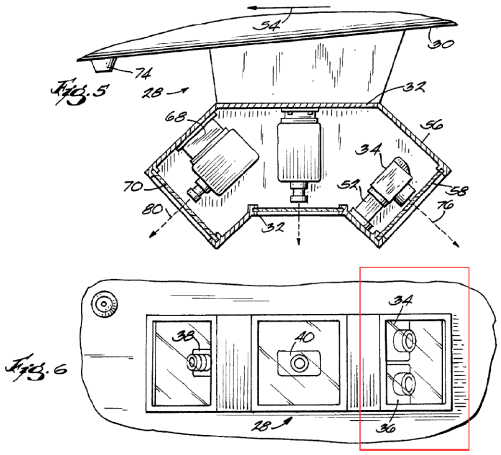
[10] While claim 1 does not require that the second image-capturing device capture oblique aerial images, I include detailed disclosures here concerning Loewen's disclosure of a second still camera that captures oblique aerial images as pertinent not only to the broader requirements of claim, but also as to coverage of narrower later limitations, including, *e.g.*, cl.4, cl.20, cl.21, and cl.26.

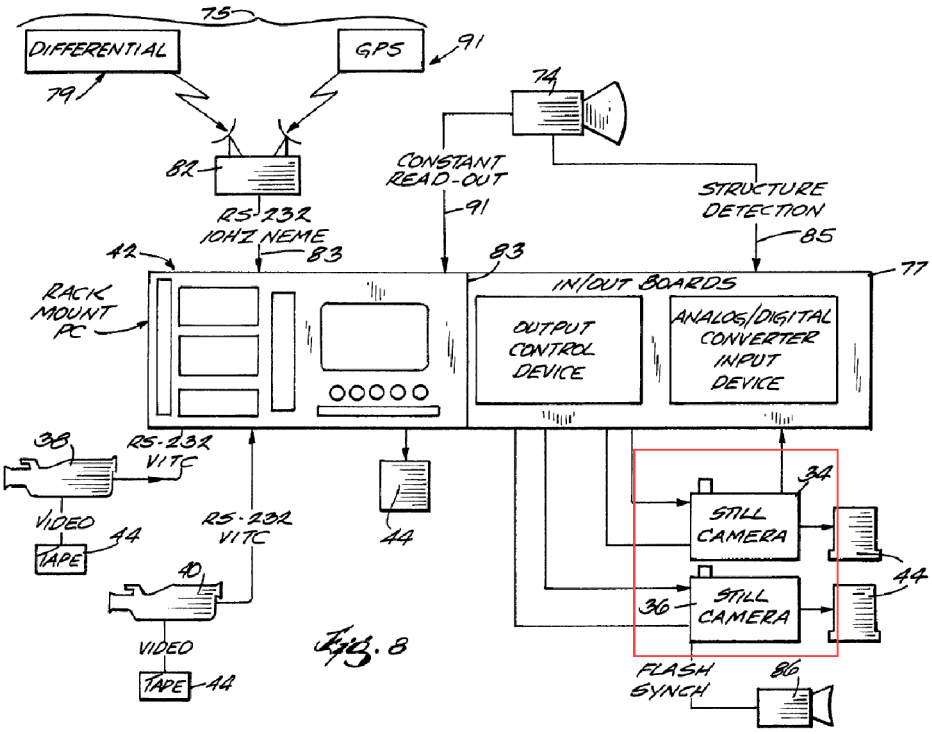
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cameras are photographing the trailing tower, i.e., trailing relative to direction of flight of the aircraft. The still photographs are taken along a line which is 30–60 degrees to the horizontal, preferably 45 degrees. Those parameters of location of the exposure point and the line of camera exposure place the cameras in close proximity to the tower being photographed to achieve high-resolution imagery for later defection investigation."), Figs. 3, 5, 6, 8:









138. As discussed above Loewen's first image-capturing device captures images at image capturing events. *See supra*, §VII.C.2. Loewen also discloses that its **second image-capturing device captures images at image-capturing events**.

And, the same disclosures regarding multiple still cameras discussed in connection with the first image capturing device apply to the second image capturing device.

139. For example, Loewen discloses "In accordance with this invention, **the still cameras take pictures of the towers from an exposure point between two adjacent towers and along an exposure line that is at a shallow angle to the horizontal.** The horizontal is defined in terms of the desired line of flight of the aircraft; the line of flight being generally parallel to the terrain over which the transmission lines are strung and over which the aircraft is flying. The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees." *E.g.*, EX1004 (**Loewen**), 2:39-49; *see also, e.g.*, *id.*, Abstract ("**The still camera**[11] **points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees.** The detecting means transmits a signal to the

[11] As this example illustrates, while Loewen sometimes refers to a single "still camera" in describing features, POSITA would have understood its teachings to be applicable to Loewen's multiple "still cameras." *E.g.*, EX1004 (**Loewen**), Abstract ("at least one still camera"), 2:36-38 ("one ***or more*** still cameras").

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central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure.").

140. Additionally, as also explained with respect to Loewen's first image-capturing device, Loewen's second image-capturing device captures images at image-capturing events trigged by Loewen's GPS and/or laser altimeter. For example, Loewen discloses that "[t]he still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device. **The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line.**" *E.g.*, EX1004 (**Loewen**), 3:3-10; *see also, e.g.*, EX1004 (**Loewen)**, 4:1-13 ("When the alternative of preloaded longitude/latitude coordinates is used, the **GPS unit is used in the activation of the still cameras.** More particularly, the GPS continuously transmits longitude/latitude coordinates to the computer and the computer determines, from the preloaded coordinate information,

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the longitude and latitude coordinates of the next or approaching tower and the distance to the next tower and to the next still camera exposure point. **The computer then calculates the time delay, taking into account the ground speed of the aircraft, until the aircraft arrives at the exposure point where the still cameras are to be operated to capture the image**. While this is taking place, the system is reset to capture the images of the next tower."), 10:50-67 ("**[T]he inspection system utilizes the inputted geographic coordinates to arm and trigger the still cameras.** More particularly, the **GPS 76 constantly monitors the location of the aircraft** relative to the tower structure geographical database. When the system detects that it has flown over a particular tower structure, that being accomplished when the detected longitude/latitude coordinates correspond to the inputted database longitude/latitude coordinates 95 (FIG. 9), the computer system is advised that the next tower will be available at a particular upcoming set of longitude/latitude coordinates. The computer then calculates 97 (FIG. 9), based on the ground speed of the aircraft, the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point), measured in feet from the tower at which point the still cameras are activated to record the images 99 (FIG. 9). The system is reset 111 for the next tower to be photographed."), 11:1-14 ("The physical detection of the presence of the tower structure is sensed and the system is enabled on that basis 105 (FIG. 10). That is, the laser altimeter is continually sensing

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the profile of the terrain with its downwardly directed beam. **As the aircraft passes over the tower structure it detects a major difference in distance from the aircraft to the top of the tower structure as compared to the distance from the aircraft to the terrain. That signal is transmitted to the computer system which then accomplishes a calculation 107 (FIG. 10) based on ground speed to enable and trigger the camera shutters 109 (FIG. 10) at a preselected distance past the tower structure.** The system is reset 111 for the next tower to be photographed."), 7:13-31 ("**The cameras provide the image-acquiring portion of the overall system. That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer.** The onboard computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not

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shown in the drawings nor described in detail."), 11:15-18 ("[T]he cameras are enabled to trigger based on actual detection of the presence of the tower structure is preferred as it is more consistent and reliable in operation."), Figs.9-10:

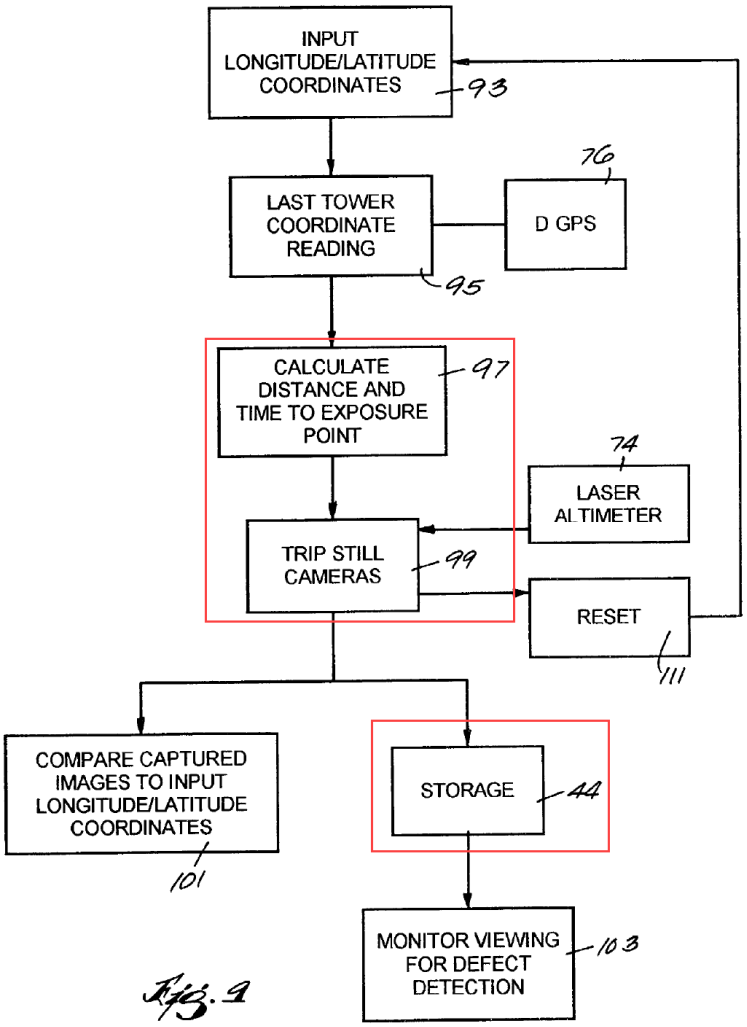


Fig. 9

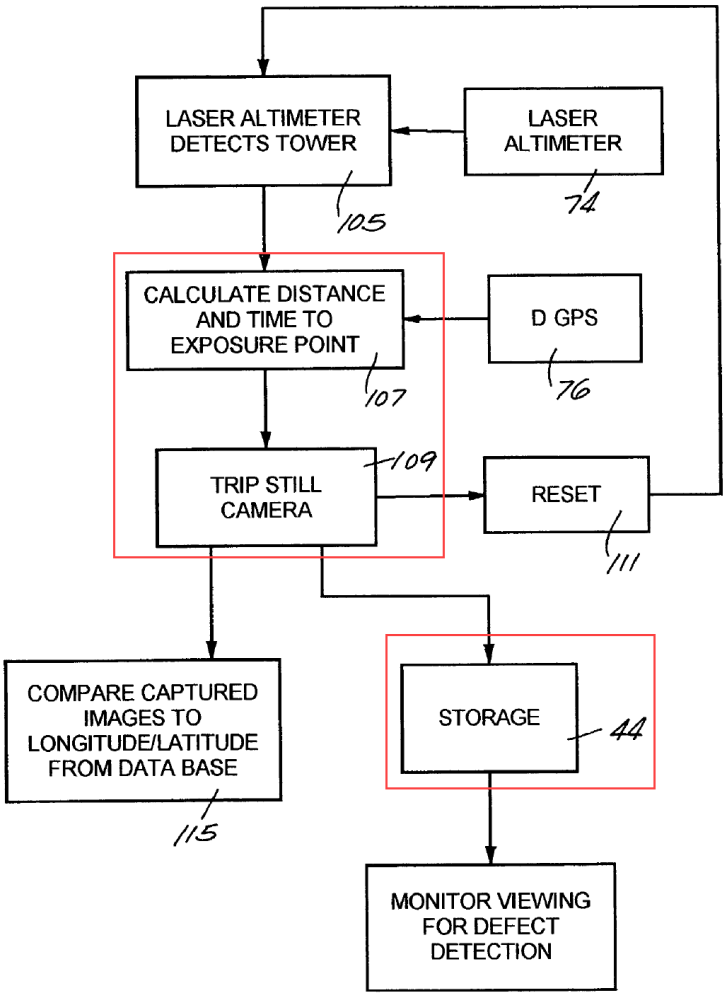


Fig. 10

141. As discussed above with respect to Loewen's first image-capturing device (*see* cl.1.a), Loewen expressly discloses, *e.g.*, that each camera issues image-data signals corresponding to images captured by that camera. *E.g.*, EX1004 (**Loewen**), 6:31-58 ("***cameras***… write their information directly to the onboard computer"), 4:31-34 ("data generated by the still ***cameras*** is transmitted, in digital form, to a data storage system on board the aircraft"). *See* n.14.

142. Further showing that Loewen's second image-capturing device issues image-data signals corresponding to its captured images, Loewen explains that "[t]he digital still cameras are supported in the pod by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The cameras look through a short tunnel section 56 of the pod housing. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses. The still cameras are preferably Kodak DCS-560 digital still cameras. These cameras produce digital still images at resolutions of over 2000 by 3000 pixels. **These cameras capture images at the rate of 1 image per 4.5 seconds and are used to capture images of the tower structures 10 at their particular locations. The still cameras write their information to a removable hard drive (conventional and therefore not shown in detail) incorporated and operatively associated with the onboard computer 42 and data storage units 44, but the cameras could write their information directly to the onboard computer via a well known and conventional firewire connection.** To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters to eliminate inconsistent trip delay times. This is preferably preformed ½ second prior to the actual trip. As will be described more completely hereinafter, the actual trip

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time is calculated either by using a GPS location and known structure locations, or by using a laser altimeter." *E.g.*, EX1004 (**Loewen**), 6:31-58, *see also, e.g.*, EX1004 (**Loewen**), 4:31-34 ("The data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft where it is stored for later retrieval and post processing as desired.").

143. Loewen further expressly explains that "[t]he data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended [from] the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way." *E.g.*, EX1004 (**Loewen**), Abstract.

* * *

144. Thus, in my opinion, Loewen discloses this limitation.

4. Element 1.c

145. Claim 1.c recites "**at least one geo-locating device, each said at least one geo-locating device issuing a corresponding at least one geo-locating signal, each said at least one geo-locating signal being indicative at least in part of a geo-location of said first image-capturing device during each first image capturing event.**" **In my opinion, Loewen discloses this limitation.**

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146. In my opinion, **Loewen discloses at least one geo-locating device** (*e.g.*, "GPS," "laser altimeter")**, each said at least one geo-locating device issuing a corresponding at least one geo-locating signal** (*e.g.*, GPS signal including, *e.g.*, "continuous longitude/latitude coordinates for the aircraft location"; "GPS, in combination with the onboard computer, continuously provides [signal including] the position of the aircraft in longitude and latitude coordinates… transmitted to the onboard computer"; "signal is generated by the laser altimeter" containing "continuous laser readings"; "input from the laser altimeter"; "continuous signal [from laser altimeter] back to the computer"")**, each said at least one geo-locating signal being indicative at least in part of a geo-location of said first image-capturing device during each first image capturing event** (*e.g.*, "GPS unit… supplies continuous longitude/latitude coordinates for the aircraft location"; "GPS… continuously provides the position of the aircraft in longitude and latitude coordinates… [and] is embedded in the collected data in association with the image… recording… longitude/latitude coordinates in association with the image"; "data" signal from "laser altimeter" indicating "height of the aircraft" and "topography of the terrain… along the right-of-way," "distance in feet above the terrain" *see* cl.1.a)**.**

147. First, in my opinion, Loewen discloses **at least one geo-locating device**.

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148. For example, Loewen explains that its system includes both a GPS and laser altimeter, both of which are geo-locating devices[12]: "[T]he tower detecting device is in the form of a **laser altimeter**…. [T]he system also contemplates the use of a **GPS** capability which cooperates in detecting the presence of a tower structure that is to be photographed." *E.g.*, EX1004 (**Loewen**), 3:11-15;[13] *see also, e.g.*, EX1004 (**Loewen**), 8:65-9:5 ("continuous laser readings").

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[12] Indeed, an altimeter, such as Loewen's laser altimeter determines the "height" of Loewen's aircraft (and thus of its image-capturing devices) "above the terrain" or "above a tower." *E.g.*, EX1004 (**Loewen**), 8:15-34. And a GPS device, such as Loewen's "GPS" determines the longitude/latitude coordinates for the aircraft location" (and thus the location of Loewen's image capturing devices). Although Loewen discloses embodiments in which either its laser altimeter or its GPS are used to detect the presence of a structure or other object to be photographed, Loewen expressly discloses an embodiment in which its system uses ***both*** a laser altimeter and a GPS for object detection such that they "cooperate[] in detecting the presence of a tower structure that is to be photographed." *E.g.*, EX1004 (**Loewen**), 3:11-15.

[13] This disclosure also shows Loewen's GPS and altimeter each issue geo-locating signals.

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149. Second, in my opinion, Loewen discloses that its **geo-locating devices issue geo-locating signals**.

150. For example, with respect to the GPS issuing signals, Loewen discloses "The **GPS, in combination with the onboard computer, continuously provides [signal including] the position of the aircraft in longitude and latitude coordinates**…**transmitted to the onboard computer**." EX1004 (**Loewen**), 3:37-50; *see also id.*, Abstract (a GPS unit which supplies **continuous longitude/latitude coordinates for the aircraft location**.").

151. With respect to the altimeter issuing geo-locating signals, Loewen discloses that its "laser altimeter beam… provides a continuous signal back to the computer of the distance in feet [above] the terrain." EX1004 (**Loewen**) 9:65-10:3; *see also* EX1004 (**Loewen**) 4:14-22 ("**a signal is generated by the laser altimeter** when it detects the presence of a tower.").

152. Third, in my opinion, Loewen discloses that **the geo-locating signals** (issued by the GPS and altimeter) **are indicative at least in part of a geo-location of a first image-capturing device during each first image capturing event**.

153. For example, as to the geo-locating signal issued by Loewen's GPS, Loewen discloses that the signal includes "continuous longitude/latitude coordinates **for the aircraft location**." *E.g.*, EX1004 (**Loewen**), Abstract. Loewen further discloses that its image-capturing devices, including the first image-capturing

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device, are mounted in the aircraft such that Loewen's GPS signals indicative at least in part of the aircraft location are also indicative at least in part of the geo-location of the first image-capturing device. *See, e.g.*, EX1004 (**Loewen**), 5:43-54; *see also, e.g.*, ¶212. Loewen also discloses that "[t]he GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates…. [T]hat data is transmitted to the onboard computer and, in accordance with another aspect of this system, is **embedded in the collected data in association with the image** of a particular tower structure." *E.g.*, EX1004 (**Loewen**), 3:37:50; *see also, e.g.*, EX1004 (**Loewen**), 4:1-13, 7:34-55, 9:6-13, 9:14-31, 10:24-43, 10:50-67, Fig.8:

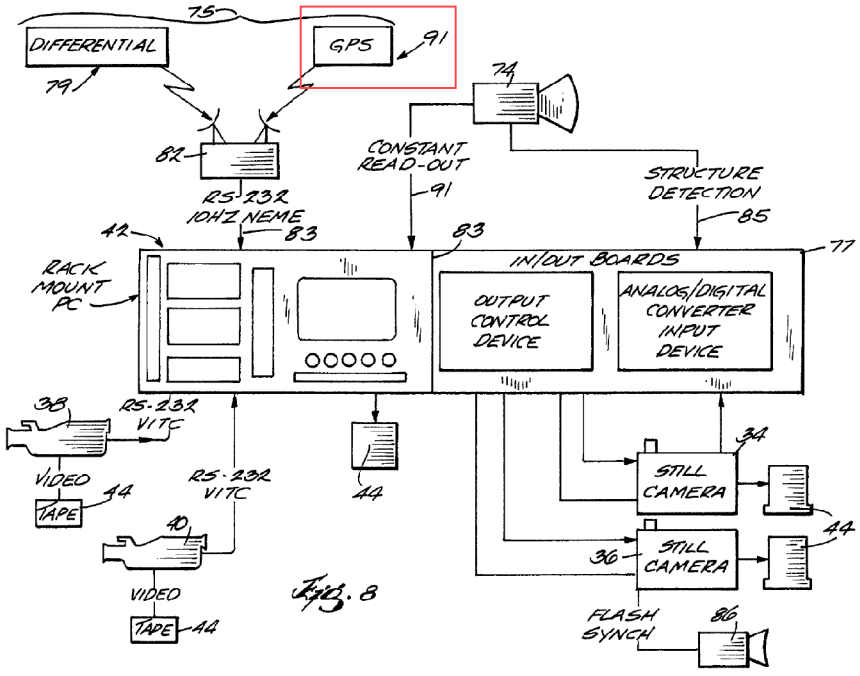


Fig. 8

154. In my opinion, Loewen's statement that the computer, determines the "exposure point for the still cameras" based on Loewen's GPS signals (EX1004 (**Loewen**), 9:20-24) is also an express disclosure and confirmation that Loewen's GPS signal is indicative at least in part of a geo-location of Loewen's image-capturing devices.

155. As to Loewen's laser altimeter signals, Loewen expressly discloses that those signals are indicative at least in part of a geo-location of Loewen's image-capturing devices because those signals include "height of the aircraft above the terrain" and the "height of the aircraft above a tower." *E.g.*, EX1004 (**Loewen**), 8:15-34 ("topography of the terrain along the right-of-way"); *see also, e.g.*, EX1004 (**Loewen**), 9:65-10:3 ("continuous signal… of the distance in feet [above] the terrain."), 8:65-9:3, 9:32-39 ("The laser altimeter trip software module has the computer responding to the input from the laser altimeter signifying the laser altimeter has identified a tower structure."). And again, Loewen discloses that its image-capturing devices, including the first image-capturing device, are mounted in the aircraft such that Loewen's altimeter signals indicative at least in part of the aircraft location (including its height) are also indicative at least in part of the geo-location of the first image-capturing device. *See, e.g.*, EX1004 (**Loewen**), 5:43-54; *see also, e.g.*, ¶212.

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156. In my opinion, POSITA would have understood Loewen discloses geolocating devices (GPS and laser altimeter) each issuing a signal indicative at least in part of both a geolocation ***of the first image-capturing device*** (including the first camera (*e.g.*, EX1004 (**Loewen**), Abstract ("a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location"), 3:37-50 ("The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates….")) during the first image-capturing event ***and*** of a geolocation ***of the subject of the photograph*** (including, *e.g.*, a photographed tower structure (*e.g.*, EX1004 (**Loewen**), 8:65-9:5, 9:14-31 ("The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., **arrive at a particular desired exposure point for the still cameras a predetermined distance past the tower**. The programming allows for varying the preselected distance, and thus the exposure point, as required or desired.") 9:65-10:3 ("laser altimeter beam… provides a continuous signal back to the computer of the distance in feet [above] the terrain") during the first image-capturing event")) during the first image-capturing event. As Loewen expressly discloses, the geolocation of the subject of the photograph, such as a tower structure or terrain, has a fixed, known relationship to the geolocation of the camera when this image is captured. *See also,*

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e.g., EX1008 (**Kain 1997**), 5:32-6:1 ("GPS data accurately represents… position of [the] cameras")

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157. Thus, in my opinion, Loewen discloses this limitation.

5. Element 1.d

158. Claim 1.d recites "**a computer system receiving and storing said first and second image-data signals and said at least one geo-locating signal.**" **In my opinion, Loewen discloses this limitation.**

159. In my opinion, **Loewen discloses a computer system** (*e.g.*, "onboard computer (a central processing unit) containing operational software"; "onboard aircraft computer 42" (Fig.8); "central processing unit containing operational software")[14] **receiving and storing said first and second image-data signals and**

[14] Loewen expressly discloses its "cameras… writ[ing] their information directly to the onboard computer" (*e.g.*, EX1004 (**Loewen**) 6:49-51), and thus that its onboard computer receives and stores the image-data signals from Loewen's image capturing devices. Loewen further discloses, alternatively, that such data can be stored on "data storage units 44," *e.g.*, "in the form of CDs and/or removable hard drives"

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said at least one geo-locating signal (*e.g.*, "still and video images, along with the geographic coordinates are transmitted to data storage units on board the aircraft"; "computer recording all the GPS data strings as well as continuous laser readings [] into a text file… file also contains… time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower"; "position of the aircraft in longitude and latitude coordinates" is "transmitted to the onboard computer"; "cameras… write their information directly to the onboard computer"; "onboard computer is interconnected with the GPS and trigger system, and also the data storage unit"; Fig.8 ("onboard aircraft computer 42"))**.**

160. First, Loewen discloses **a computer system**. For example, Loewen describes a computer system, including a computer (*e.g.*, "central processing unit") that contains "operational software," and that is connected not only to Loewen's

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(*e.g.*, EX1004 (**Loewen**), 7:59-61) that are "incorporated and operatively associated with the onboard computer." *E.g.*, EX1004 (**Loewen**), 6:45-49. Such "data storage units" (*e.g.*, "CDs and/or removable hard drives... interconnected with the onboard computer") are thus not separate computer systems, but are part of ("incorporated and operatively associated with") the same "onboard computer" system that runs software executing each of Loewen's system's functions.

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cameras, but also to its tower detecting means, and that the computer stores the image-data signals from Loewen's image-capturing devices. For example, Loewen discloses "**[t]he still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device**. The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line." *E.g.*, EX1004 (**Loewen**), 3:3-10. *See also* EX1004 (**Loewen**), Fig. 8 ("onboard aircraft computer 42"), Abstract ("**central processing unit containing operational software**").

161. Second, Loewen discloses the computer system **receiving and storing said first and second image-data signals**. As a preliminary matter, Loewen explains that its computer system acquires location data, triggers Loewen's image-capturing devices, and is equipped with a data storage unit or onboard storage: "**[t]he cameras provide the image-acquiring portion of the overall system. That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer.** The onboard

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computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail." *E.g.*, EX1004 (**Loewen**), 7:13-31; *see also, e.g.*, *id.*, Fig. 8 (annotated):

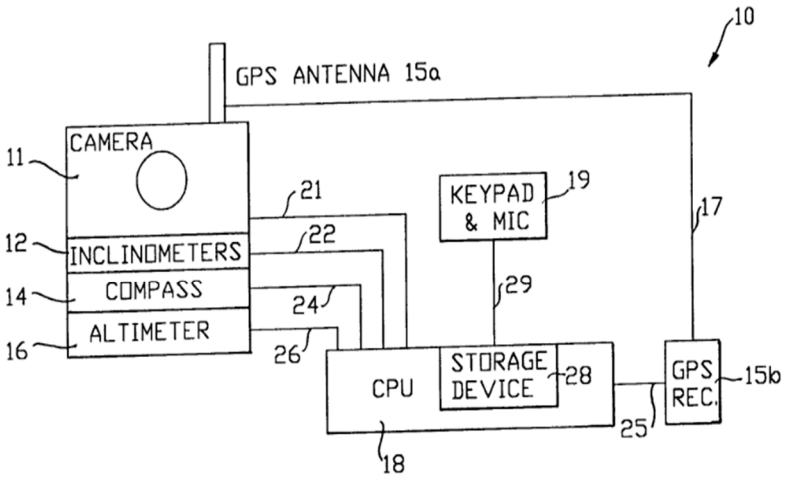


FIG. 1

162. More specifically, Loewen discloses that the images from the first and second still cameras are received by (transmitted to) the computer system and stored (in the onboard computer system). For example, Loewen discloses "**still and video**

images, along with the geographic coordinates are transmitted to data storage units on board the aircraft." *E.g.*, EX1004 (**Loewen**), 3:51-57. Further, Loewen's cameras take pictures of, e.g., the towers, and Loewen discloses storing the images of the tower in a database. *E.g.*, EX1004 (**Loewen**), 3:37-50.

163. Indeed, Loewen expressly states that its image-capturing devices (*e.g.*, "still cameras") store the images in the computer, describing, *e.g.*, that the cameras "**write their information directly to the onboard computer**": "The digital still cameras are supported in the pod by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The cameras look through a short tunnel section 56 of the pod housing. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses. The still cameras are preferably Kodak DCS-560 digital still cameras. These cameras produce digital still images at resolutions of over 2000 by 3000 pixels. These cameras capture images at the rate of 1 image per 4.5 seconds and are used to capture images of the tower structures 10 at their particular locations. **The still cameras write their information to a removable hard drive (conventional and therefore not shown in detail) incorporated and operatively associated with the onboard computer 42 and data storage units 44, but the cameras could write their**

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information directly to the onboard computer via a well known and conventional firewire connection. To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters to eliminate inconsistent trip delay times. This is preferably preformed ½ second prior to the actual trip. As will be described more completely hereinafter, the actual trip time is calculated either by using a GPS location and known structure locations, or by using a laser altimeter." *E.g.*, EX1004 (**Loewen**), 6:31-58; *see also, e.g.*, n.14; EX1004 (**Loewen**), 7:59-61 ("The data storage 44 can be in the form of CDs and/or removable hard drives, again interconnected with the onboard computer."), 11:19-28 ("Whichever mode of operation is used, **the imaging data acquired is transmitted to the suitable storage media 44, for example, CDs or removable hard drives**, for later downloading. This downloading can be for one of two purposes. **In the instance of archiving the location of the tower structures it would be to establish the basic database for the transmission line company.** In another mode, it would be downloaded and compared with the already existing database for the location of the tower structures to identify any tower structures that may have been missed in the fly over 101 (FIG. 9)."), Figs.9-10:

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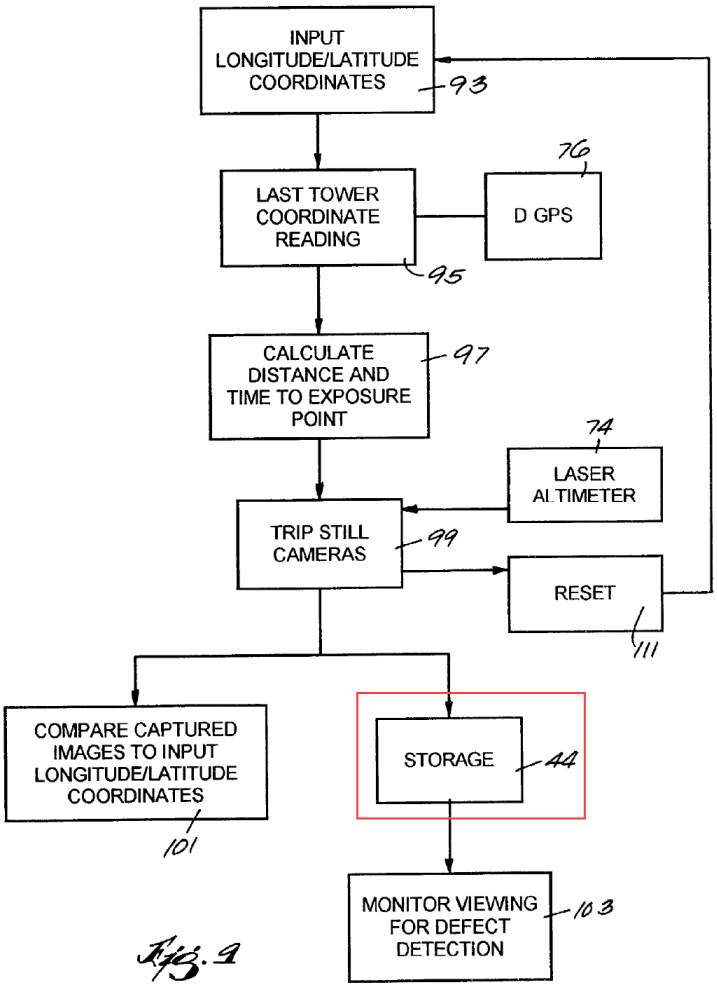

INPUT LONGITUDE/LATITUDE COORDINATES
93
LAST TOWER COORDINATE READING
95
D GPS
76
CALCULATE DISTANCE AND TIME TO EXPOSURE POINT
97
LASER ALTIMETER
74
TRIP STILL CAMERAS
99
RESET
111
COMPARE CAPTURED IMAGES TO INPUT LONGITUDE/LATITUDE COORDINATES
101
STORAGE
44
MONITOR VIEWING FOR DEFECT DETECTION
103

Fig. 9

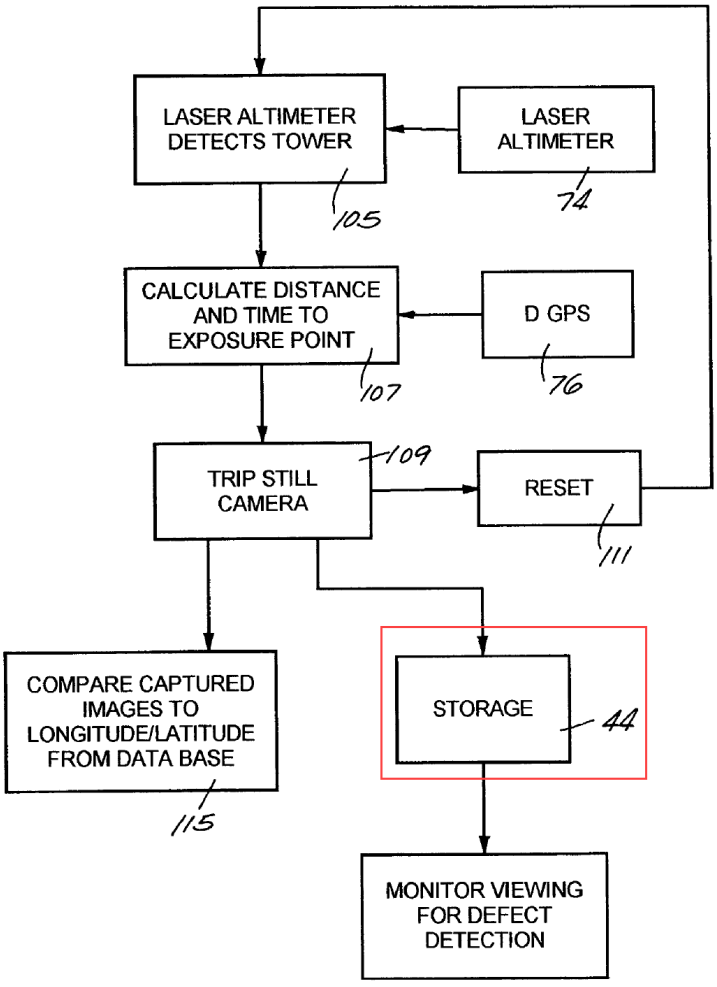


Fig. 10

164. Third, Loewen discloses that its **computer system receives and stores at least one geo-locating signal** (e.g., from Loewen's GPS and/or laser altimeter). For example, Loewen discloses that "[t]he GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates. **In accordance with this system, that data is transmitted to the onboard computer and, in accordance with another aspect of this system, is**

embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower. This recording of the tower location in longitude/latitude coordinates in association with the image of each tower provides an inventory database of all of the towers along a particular transmission line. The embedding of geographical location can be done in association with images captured by both the still and video cameras." *E.g.*, EX1004 (**Loewen**), 3:37-50; *see also, e.g.*, EX1004 (**Loewen**), 7:34-55 ("In the preferred embodiment, the GPS 76, in its preferred form, is a differential system (DGPS) 78 of the type commercially available and referred to as a SATLOK L-Band differentially corrected GPS unit. The use of the DGPS enhances the accuracy of the geographical locating ability of the system. As illustrated, this unit operates off of two satellites 79 and 81 and produces sub-meter accuracy. The data from the GPS is transmitted to the computer via standard NEMA format at 10 Hz frequency, line 83. The differential signal is received by the omni-star system which means that it receives its correction information from satellites 79 and 81. This allows for continental coverage at all times. This unit is also connected to the daylight readable front mounted display 46 that allows the pilot to view signal quality as well as all times without having to look inside the cockpit. **The GPS sends real time corrected latitude/longitude readings to the computer** and the computer is then able to

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perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing. The GPS unit 76, particularly its antenna, can be supported at a convenient position on the exterior of the aircraft fuselage."), 9:14-31 ("In the GPS camera trip mode (FIG. 9), the GPS camera trip software module requires that the computer be given the latitude/longitude location of every tower that is to be filmed. The computer then steadily calculates the distance from a last GPS reading at 95 the last tower encountered to the first tower location to be encountered after that last tower GPS reading. The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., arrive at a particular desired exposure point for the still cameras a predetermined distance past the tower. The programming allows for varying the preselected distance, and thus the exposure point, as required or desired. The system is reset 101 with the next trip location being loaded into the computer and the camera trip program starts over again. **During the camera trip the computer program records the time and location of the trip into a separate file for post processing of the images.**"), 9:32-39 ("The laser altimeter trip software module has the computer responding to the input from the laser altimeter signifying the laser altimeter has identified a tower structure. The program then calculates, using the ground speed, to apply the proper time delay to trigger the still cameras at the desired exposure point. Again **the program records the time of the trip along**

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with the geographic longitude/latitude coordinates of that tower location."); *see also, e.g.*, *id.*, 9:40-47 ("A post processing software module is provided to perform two separate duties. One is to extract latitude/longitude readings of every tower structure and the other 101 is to coordinate the captured images with the original trip file containing the tower locations and identify any possible missed or extra images and then label all images to pre-determined standards, i.e., an AIS (asset inventory system) format."), 10:24-43 ("In one embodiment, and assuming the objective is to obtain both an inventory of the tower structures and an inspection of the towers and related equipment of a particular transmission line, an initial fly over is executed to provide basic data on the location of the towers. In that operation, the aircraft flies the transmission line with the video cameras operational. As the aircraft passes over a particular tower structure (sensed by the laser altimeter), **the longitude/latitude coordinates are identified by the GPS and embedded in the imaging database in association with that particular tower structure**. The system is also capable of assigning an inventory number to that tower structure. This is done for the entire transmission line being processed. This initial step would be utilized where the transmission line company does not already have established inventory database of the location of its towers. If the transmission line company has an established inventory database of its tower locations, by longitude/latitude, the initial fly over step is eliminated and the data on tower location is inputted from that database.").

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165. Confirming that Loewen stores both its image data and geo-locating data, Loewen expressly explains that it keeps a "record of the respective location of the power line towers," stating, *inter alia*, that the "invention relates to an airborne inventory and inspection system designed **to obtain high resolution images** of electric transmission power lines, the power line right-of-way and the support structure towers, **along with a record of the respective location of the power line towers**, which system is an improvement over current accepted systems and can be performed at a cost that makes use of this system more cost effective than alternatives available to the electrical power transmission industry." *E.g.*, EX1004 (**Loewen**), 1:16-24; *see also, e.g.*, *id.* 2:50-3:2 ("More specifically, the aircraft is flown along the transmission line at a low altitude, preferably 60–100 feet above the tops of the tower structures. The aircraft speed is in the range of 80–100 miles per hour. That altitude and speed allow the use of advantageous exposure parameters (shutter speed, lens opening and resulting depth of field) for the cameras such as to result in capturing the high quality, still, high resolution images. **Also, at that speed, sufficient time is available for the transfer of imaging data from the cameras to storage and for resetting the cameras to capture images of the next, upcoming tower.** Placing the exposure point for the still cameras between the adjacent towers and at the shallow angle to the horizontal produces high-resolution images; flying at the above-described altitude contributes to the high-resolution imagery. The

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exposure point, angle of the line on which the still cameras take the pictures, and the altitude of the aircraft are all factors in insuring that images of at least the upper portion of the tower carrying the transmission lines, the electric insulators, and hardware are properly framed in the picture."); *see also, e.g.*, EX1004 (**Loewen**), 3:51-57 ("The **still and video images, along with the geographic coordinates are transmitted to data storage units on board the aircraft** for post processing or other future use as desired. For example, post processing can be visual inspection, tower by tower, on a suitable monitor for detection of structural defects."), 4:31-34 ("**The data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft** where it is stored for later retrieval and post processing as desired.").

166. Loewen also expressly discloses storing its GPS and laser altimeter signals, explaining that "**[a] laser survey module (i.e., terrain mapping) has the computer recording all the GPS data strings as well as continuous laser readings 91 into a text file. This file also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower** the same as was described above in connection with the video survey module." *E.g.*, EX1004 (**Loewen**), 8:65-9:5.

* * *

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167. Thus, in my opinion, Loewen discloses this limitation.

6. Element 1.e

168. Claim 1.e recites "**the computer system executing image and data acquiring software reading said first and second image-data signals and said at least one geo-locating signal, said image and data acquiring software associating each said first or second image-data signal with a corresponding said at least one geo-locating signal for each image-capturing event.**" **In my opinion, Loewen discloses or renders obvious this limitation.**

169. In my opinion, **Loewen discloses the computer system** (*see* cl.1.d) **executing image and data acquiring software reading said first and second image-data signals and said at least one geo-locating signal** (*e.g.*, "an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device" (*e.g.*, GPS and/or laser altimeter); "airborne inspection software" including "airborne capture software" that, *e.g.*, "has the computer recording all the GPS data strings as well as continuous laser readings" and receives the "image of a particular tower" and "post processing software module" that, *e.g.*, "extract[s] latitude/longitude readings of every tower structure" and "coordinate[s] the capture images with the original trip file"; "software programing… embedding the longitude/latitude coordinates for… the still camera output… pursuant to operational instructions, in association with the image

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of a particular tower"; "interaction between the onboard computer and the various pieces of system equipment are all coordinated and rendered operable on the basis of appropriate operating or executable software programs")**, said image and data acquiring software associating each said first or second image-data signal with a corresponding said at least one geo-locating signal for each image-capturing event** (*e.g.*, "[w]ith the appropriate software programming as mentioned above, … embedding the longitude/latitude coordinates for… the still camera output pursuant to operational instructions, in association with the image"; "coordinat[ing] the captured images with the original trip file containing the tower locations… label all images to pre-determined standards"; "embedding of geographical location… with images captured by both the still and video cameras"; "embed[ding] longitude/latitude coordinates of… tower location on the corresponding tower image… from… still cameras"; "recording of the tower location in longitude/latitude coordinates in association with the image of each tower"; "longitude/latitude coordinates are identified by the GPS and embedded in the imaging database in association with the particular tower structure")**.**

170. First, as a general matter, Loewen teaches that its **computer system executes software** that performs the functions of its system. For example, Loewen discloses "**an onboard computer (a central processing unit) containing operational software** and operatively connected to the cameras and the tower

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detecting device. The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line." *E.g.*, EX1004 (**Loewen**), 3:3-10. Loewen further explains "the **interaction between the onboard computer and the various pieces of system equipment are all coordinated and rendered operable on the basis of appropriate operating or executable software programs which are a functional part of the onboard computer operation**. The actual details of the software programming are not essential to an understanding of this invention and can be achieved with conventional programming techniques." *E.g.*, EX1004 (**Loewen**), 8:35-43; *see also, e.g.*, EX1004 (**Loewen**), 8:47-53 ("In general terms, the airborne inspection software is comprised of two setup stages, airborne capture and post processing. The airborne capture software can be considered as being made up of different operational modules that can be run either separately, or together as needed. The modules include a video module, a laser survey module, a GPS camera trip module, and/or laser altimeter trip module.").

171. Second, Loewen discloses the computer system **executing image and data acquiring software reading said first and second image-data signals and said at least one geo-locating signal**. In other words, the software of Loewen's

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system reads (accesses[15]) the received (and stored) image-data signals and at least one geo-locating signal before acting on these pieces of data—*i.e.*, proceeding to associate them—as discussed below.

172. POSITA would have understood that the "software programming" on Loewen's onboard computer, in *embedding* Loewen's stored geo-location data from its geo-locating devices (including its GPS) into its stored image data from Loewen's image-capturing devices, is *reading* (accessing) that stored image data and geo-locating signal data as part of combining them: "The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude. **With the appropriate software programming as mentioned above, the system is capable of embedding the longitude/latitude coordinates for** either the video output or **the still camera output. That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association**

[15] POSITA would have understood Loewen's reference to "reading" data as accessing the data. This is consistent with how the '657 patent uses the term "reading" (*e.g.*, EX1001 (**'657**), 3:15-17 ("***reading*** the data file"); *see also, e.g.*, 5:33-38 ("Memory… includes… ***read***-only memory")), as well as its common usage by POSITA at the time.

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with the image of a particular tower." *E.g.*, EX1004 (**Loewen**), 9:6-13. *See also infra* ¶¶173-177.

173. Third, Loewen discloses that its **image and data acquiring software associat[es] each said first or second image-data signal with a corresponding said at least one geo-locating signal for each image-capturing event**. For example, as noted above, Loewen discloses that the "software programming" on its onboard computer embeds the GPS signal including longitude/latitude coordinates with "the image of a particular tower": "The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude. **With the appropriate software programming as mentioned above, the system is capable of embedding the longitude/latitude coordinates for… the still camera output. That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association with the image of a particular tower.**" *E.g.*, EX1004 (**Loewen**), 9:6-13.

174. Loewen further discloses that its "post processing software module… **coordinate[s] the captured images with the original trip file containing the tower locations**" (which POSITA would have understood to be the "integrated text file for post processing," which contains the "continuous laser readings" from the laser altimeter), and "label all images to pre-determined standards." Thus, Loewen expressly discloses that its computer system software (which executes the functions

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of Loewen's system) associates (as a result of either or both of Loewen's "coordinat[ing]" and "label[ing]") each image-data signal from Loewen's image-capturing devices (*e.g.*, still cameras) with the corresponding geo-locating signals generated by Loewen's laser altimeter. In my opinion, POSITA would have understood that, for each image-capturing event, Loewen's computer system (including its software that executes the functions of Loewen's system) associates each image-data signal from Loewen's image-capturing devices with the geo-locating signal generated by Loewen's laser altimeter. Indeed, Loewen expressly discloses that its laser altimeter readings are stored in "a text file" that "also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower the same as was described above in connection with the video survey module" (*e.g.*, EX1004 (**Loewen**), 8:65-9:5), and that collected geo-locating information is "saved as a single integrated text file for post processing" to "provide a database of the right-of-way, all of the towers along the right-of-way, and the longitude/latitude coordinates for each tower." *E.g.*, EX1004 (**Loewen**), 8:54-64.

175. As a further disclosure of Loewen's software (image and data acquiring software) associating each said first or second image-data, Loewen repeatedly explains that its GPS signal is associated (*e.g.*, "embedded") with its image-data signals for each image-capturing event and that this is performed by Loewen's

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onboard computer. POSITA would have understood that the software of Loewen's computer performs those functions (as discussed above, ¶172): "The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates. In accordance with this system, **that data is transmitted to the onboard computer and, in accordance with another aspect of this system, is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower. This recording of the tower location in longitude/latitude coordinates in association with the image of each tower provides an inventory database of all of the towers along a particular transmission line. The embedding of geographical location can be done in association with images captured by both the still and video cameras.**" *E.g.*, EX1004 (**Loewen**), 3:37-50; *see also, e.g.*, *id.*, 7:13-31 ("The cameras provide the image-acquiring portion of the overall system. That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. **The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer. The onboard computer receives and sends out all its required signals via conventional RS-232 ports.** The computer is connected to and

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operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."); 7:34-55 ("The GPS sends real time corrected latitude/longitude readings to the computer and the computer is then able to perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing."), 3:51-57 ("**The still and video images, along with the geographic coordinates are transmitted to data storage units on board the aircraft for post processing or other future use as desired**. For example, post processing can be visual inspection, tower by tower, on a suitable monitor for detection of structural defects."), 10:4-13 ("[T]he laser altimeter 74 will detect the passage of the aircraft over a tower structure and generate a signal at that point. The signal is used to enable the system to **embed the longitude/latitude coordinates of that tower location on the corresponding tower image,** either the output from the video or **the output from the still cameras**, or both. This provides a continuous identification of the geographical location of the towers in the power line."). *E.g.*, EX1004 (**Loewen**), 10:4-13; *see also, e.g.*, EX1004 (**Loewen**), Fig.8:

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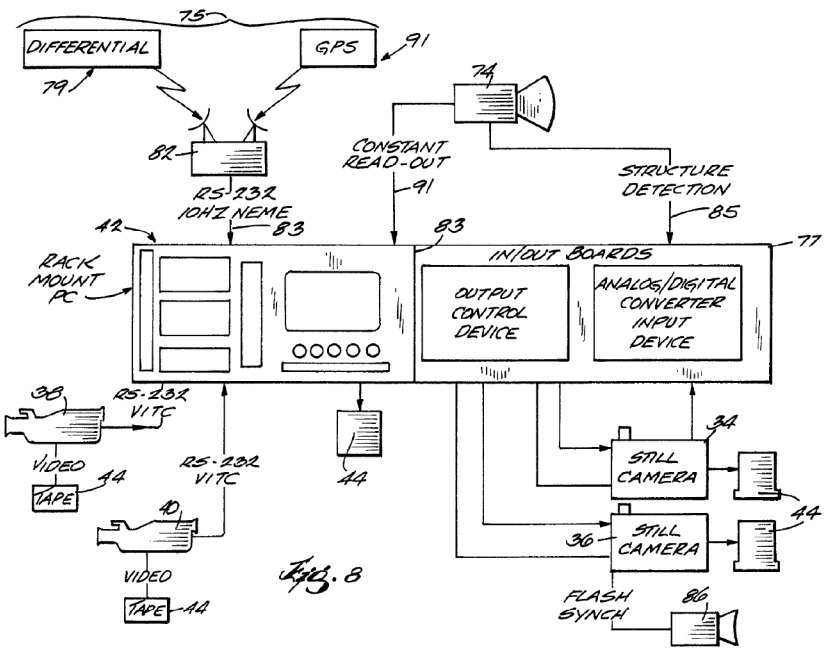


Fig. 8

176. Loewen also discloses that its computer system "coordinate[s] the captured images with the original trip file" (which contains "continuous laser readings" from Loewen's laser altimeter, *e.g.*, EX1004 (**Loewen**), 8:65-9:5) and "label[s] all images" with such data, including data from Loewen's laser altimeter: "A post processing software module is provided to perform two separate duties. One is to extract latitude/longitude readings of every tower structure and the other 101 is to **coordinate the captured images with the original trip file containing the tower locations and identify any possible missed or extra images and then label all images to pre-determined standards**, i.e., an AIS (asset inventory system) format." *E.g.*, EX1004 (**Loewen**), 9:40-47.

177. To the extent it is argued that further disclosure of Loewen's computer system software associating each image-data signal from Loewen's image capturing

devices with the geo-locating signals generated by Loewen's laser altimeter, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed computer system associating geo-locating signals (such as *GPS signals*) with image-data signals captured by Loewen's image-capturing devices using Loewen's additional disclosure of *laser altimeter signals* corresponding to each image-capturing event, such that in the resulting system Loewen's computer system additionally associates each image-data signal with a corresponding laser altimeter signal.** POSITA would have recognized that implementing Loewen's system with this additional geo-locating signal associated with Loewen's image-data signals would have advantageously permitted POSITA to record the system's height and the height of objects captured in images in order to derive more accurate georeferenced imagery. Further, POSITA would have recognized that associating an additional geo-locating signal with Loewen's image-data signals would have been beneficial because it would have added further precision to the georeferencing performed by Loewen's computer system. For POSITA, this would have been an obvious, routine implementation choice, and clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

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178. Thus, in my opinion, Loewen discloses or renders obvious this limitation.

7. Element 1.f

179. Claim 1.f recites "**wherein the computer system transmits image-capture signals to the first image-capturing device and the second image-capturing device to cause the first and second image-capturing devices to capture images, and wherein the computer system controls the first and second image-capturing devices separately.**" As an initial matter, and as discussed (*see* §V.C), I understand that the term "the computer system controls the first and second image-capturing devices separately" requires "control data sent by the computer system that cause image-capturing devices to capture images at different instants and/or at different intervals." **In my opinion, Loewen in view of Fujimoto renders obvious this limitation.**

180. In my opinion, **Loewen discloses that the computer system** (*see* cl.1.d) **transmits image-capture signals to the first image-capturing device and the second image-capturing device** (*see* cl.1.a, cl.1.b) **to cause the first and second image-capturing devices to capture images** (*e.g.*, "still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device;" "still

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cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line"; "still camera" "trigger[ed]… to acquire the images"; "[to] fire the still cameras, the computer must pre-arm the camera prior to… the actual trip"; "cameras… trigger[ed] based on actual detection of the presence of the tower structure"; *see also* cl.1.a; cl.1.b)**.**

181. In my opinion, Loewen's **computer system transmits image-capture signals to the first image-capturing device and the second image-capturing device** (Loewen's still cameras) **to cause the first and second image-capturing devices to capture images** (captured "at the exposure point")**.** For example, Loewen expressly discloses that the computer "activate[s]" the still cameras, that exposure of its still cameras is "automated," and that this is controlled by Loewen's onboard computer: "The still cameras exposure is automated **by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device. The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line.**" *E.g.*, EX1004 (**Loewen**), 3:3-10. *See also id.* Abstract ("The central processing unit calculates the time delay necessary for said aircraft to fly past

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the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. **The still camera is activated at the exposure point to acquire an image of the tower structure"**), Fig.8 (arrow from "onboard computer 42" to "still cameras 34 and 36").

182. More specifically, Loewen expressly discloses the use of signals transmitted from Loewen's GPS and altimeter to Loewen's computer, which in turn triggers Loewen's still cameras to capture images of, *e.g.*, "exposure points along the transmission line," including when the onboard computer detects the presence of a "tower structure." *E.g.*, EX1004 (**Loewen**), Abstract, 3:3-10, 4:14-22 ("signal is generated by the laser altimeter when it detects the presence of the tower. That signal is transmitted to the computer and the computer… activate[s] the still cameras at the exposure point…."), 10:50-67 ("GPS… constantly monitors the location of the aircraft relative to the tower structure in the geographical database. When the system detects that it has flown over a particular tower structure… [t]he computer system then calculates… the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point)… at which point

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he still cameras are activated."), 6:31-58 ("[to] fire the still cameras, the computer must pre-arm the camera prior to… the actual trip").[16]

183. Loewen also discloses capturing "continuous laser readings" of, *e.g.*, "terrain" within the right-of-way (*e.g.*, EX1004 (**Loewen**), 8:65-9:5), and that Loewen's laser altimeter transmits a signal to Loewen's computer, which in turn triggers Loewen's still cameras to capture an image when, *e.g.*, the laser altimeter detects a difference in height of the aircraft above a structure such as a tower, "as compared to height of the aircraft above the terrain." *E.g.*, EX1004 (**Loewen**), 8:27-35. Based on these disclosures, POSITA would have understood that Loewen's laser altimeter would also have detected, *e.g.*, the presence of structures or objects in the right-of-way, and upon detection of such structures or objects would send a signal to Loewen's computer, which in turn would have triggered Loewen's still cameras

[16] While claim 1 does not require triggering the image-capturing devices in response to receiving a geo-locating signal, I include detailed disclosures here concerning Loewen's use of both GPS and altimeter signals transmitted to Loewen's onboard computer to cause the onboard computer to trigger Loewen's image-capturing devices as pertinent not only to the broader requirements of claim 1, but also as to coverage of narrower later limitations, including, *e.g.*, cl.4, cl.20, cl.21, and cl.26.

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to capture images of such structures or objects when detected, consistent with Loewen's teachings that its system obtains information about and "inspect[s] the right-of-way" "to detect problems in the right-of-way," such as an unauthorized structure or vehicle. *E.g.*, EX1004 (**Loewen**), 1:28-53, 2:19-21, 5:34-42 ("inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees and other plant growth or the like have encroached into the right-of-way and is presenting a potential interference with the transmission lines"). Thus, in my opinion, Loewen expressly discloses that its computer system transmits image-capture signals to Loewen's image-capturing devices to capture images of the right-of-way in response to Loewen's laser altimeter detecting structures or objects therein.

184. To the extent it is argued further disclosure of transmitting image-capture signals to Loewen's image-capturing devices to capture images of the right-of-way in response to Loewen's laser altimeter detecting structures or objects therein is required, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed computer system, which transmits image-capture signals to the first image-capturing device and the second image-capturing device, to cause the first and second image-capturing devices to capture images in response to Loewen's laser altimeter detecting structures or objects in the right-of-way.** POSITA would

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have recognized that doing so would have advantageously triggered capture of images when Loewen's laser altimeter sensed the actual presence of structures or objects in the right-of-way, in furtherance of Loewen's express goal of "inspect[ing] the integrity of the right-of-way," and "in a cost-effective manner." *E.g.*, EX1004 (**Loewen**), 2:19-21. For POSITA, this would have been an obvious, routine implementation choice and (particularly given Loewen's express disclosure of triggering the capture of images using Loewen's still cameras as a result of signals from Loewen's laser altimeter) clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

185. Loewen discloses that its computer system transmits image-capturing signals to cause Loewen's image-capturing devices to capture images, explaining that upon receiving a signal from its GPS, Loewen's computer system causes Loewen's image-capturing devices to capture images, explaining that a "mechanism 74 for triggering the still cameras" to acquire images, explaining that "[t]he cameras provide the image-acquiring portion of the overall system. **That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment.** The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer. The onboard computer receives and

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sends out all its required signals via conventional RS-232 ports. **The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status.** Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail." *E.g.*, EX1004 (**Loewen**), 7:13-31, Fig.8 (arrows from onboard computer to cameras denoting "control of various camera functions" including camera tripping:

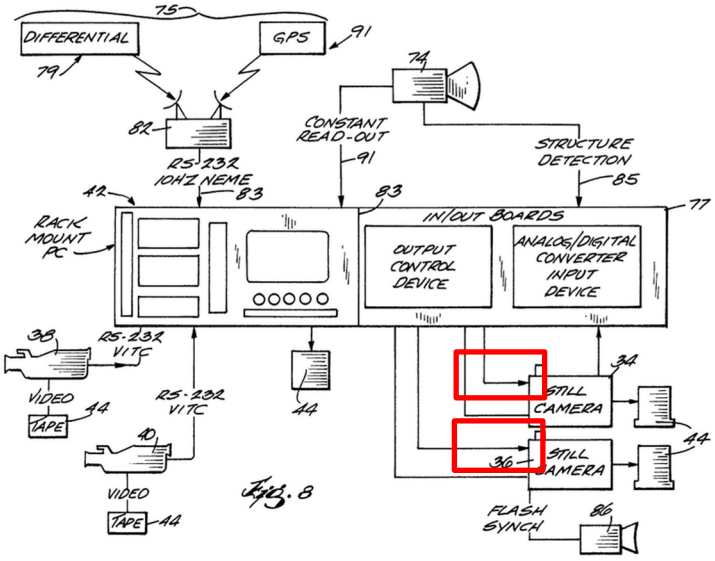


Fig. 8

186. As a further example of Loewen's computer system transmitting image-capture signals to Loewen's image-capturing devices, Loewen discloses that

latitude/longitude coordinates from its GPS unit are transmitted to Loewen's computer, which in turn triggers Loewen's image-capturing devices to capture images, as required by the claims of the '657 patent: "When the alternative of preloaded longitude/latitude coordinates is used, the **GPS unit is used in the activation of the still cameras.** More particularly, the GPS continuously transmits longitude/latitude coordinates to the computer and the computer determines, from the preloaded coordinate information, the longitude and latitude coordinates of the next or approaching tower and the distance to the next tower and to the next still camera exposure point. **The computer then calculates the time delay, taking into account the ground speed of the aircraft, until the aircraft arrives at the exposure point where the still cameras are to be operated to capture the image**. While this is taking place, the system is reset to capture the images of the next tower." *E.g.*, EX1004 (**Loewen**), 4:1-13; *see also, e.g.*, EX1004 (**Loewen**), 7:34-55 ("The GPS sends real time corrected latitude/longitude readings to the computer and the computer is then able to perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing."), 10:50-67 ("**The inspection system utilizes the inputted geographic coordinates to arm and trigger the still cameras**. More particularly, the **GPS 76 constantly monitors the location of the aircraft** relative to the tower structure geographical database. When the system detects that it has flown over a particular tower structure, that being

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accomplished when the detected longitude/latitude coordinates correspond to the inputted database longitude/latitude coordinates 95 (FIG. 9), the computer system is advised that the next tower will be available at a particular upcoming set of longitude/latitude coordinates. The computer then calculates 97 (FIG. 9), based on the ground speed of the aircraft, the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point), measured in feet from the tower at which point **the still cameras are activated to record the images** 99 (FIG. 9). The system is reset 111 for the next tower to be photographed.").

187. As another example of Loewen's laser altimeter sending a signal to Loewen's onboard computer to instruct the computer to transmit an image-capture signal to Loewen's image-capturing devices, Loewen expressly discloses that its computer system (and software executing the functions of Loewen's system), transmit image-capture signals to Loewen's still cameras to cause the still cameras to capture images in response to detection by Loewen's laser altimeter[17] of, *e.g.*, a "major difference in distance from the aircraft to the top of the tower structure": "[T]he physical detection of the presence of the tower structure is sensed and the system is enabled on that basis 105 (FIG. 10). That is, the laser altimeter is

[17] *See* n.16.

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continually sensing the profile of the terrain with its downwardly directed beam. **As the aircraft passes over the tower structure it detects a major difference in distance from the aircraft to the top of the tower structure as compared to the distance from the aircraft to the terrain. That signal is transmitted to the computer system which then accomplishes a calculation 107 (FIG. 10) based on ground speed to enable and trigger the camera shutters 109 (FIG. 10) at a preselected distance past the tower structure**. The system is reset 111 for the next tower to be photographed." *E.g.*, EX1004 (**Loewen**), 11:1-14; *see also, e.g.*, *id.*, 11:15-18 ("The second embodiment wherein **the cameras are enabled to trigger based on actual detection of the presence of the tower structure** is preferred as it is more consistent and reliable in operation."); *see also, e.g.*, *id.*, Fig. 8 (annotated).

188. In my opinion, **Fujimoto discloses controlling multiple image-capturing devices separately** (*e.g.*, "a computerized control for opening the shutters of a plurality of cameras independently of one another"; "computerized control for aerial photography… each shutter… driven at independently different interval time").

189. For example, Fujimoto expressly discloses independent, computerized control of cameras capturing aerial images, explaining, *e.g.*, that "[t]he present invention aims at overcoming such difficulties, and has for its object to provide **a computerized control for opening the shutters of a plurality of cameras**

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independently of one another thereby to secure a series of photographs of the ground without the waste of film." *E.g.*, EX1005 (**Fujimoto**), ¶0004. Fujimoto further teaches, *e.g.*, that each camera shutter is "driven at independently different interval time": "According to the invention, a **computerized control for aerial photography** includes means for inputting as data the altitude and speed of flight, means for setting the overlap rate between the adjacent photographs and the lens angles, an arithmetic unit for calculating interval time through arithmetical operations on said altitude, speed, overlap rate and lens angles, and an output device for producing shutter driving signals at said interval time resulting from said arithmetical operations, said. signals being produced with respect to all the cameras mounted in the aeroplane, **thereby enabling each shutter to be driven at independently different interval time**." *E.g.*, EX1005 (**Fujimoto**), ¶0006; *see also, e.g.*, EX1005 (**Fujimoto**), cl.1 ("**A computerized control for aerial photography**, comprising means for inputting as data the altitude and speed of flight, means for setting the overlap rate between the adjacent photographs and the lens angles, an arithmetic unit for calculating interval time through arithmetical operations on said altitude, speed, overlap rate and lens angles, and an output device for producing shutter driving signals at said interval time resulting from said arithmetical operations, said **signals being produced with respect to all the**

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cameras mounted in the aeroplane, thereby [e]nabling each shutter to be driven at independently different interval time.").

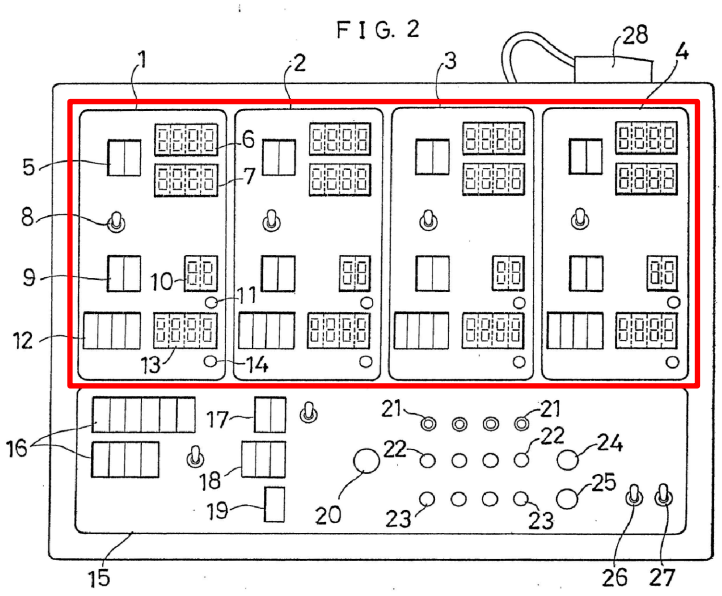
190. Fujimoto explains that one benefit of its disclosed independent camera control is to avoid taking unnecessary photographs of the area of interest when using multiple (two or more) cameras: "**For an aeroplane having two or more cameras with different lens angles, the intervals between operations of the shutters of all the cameras are controlled to ensure full coverage of the area being photographed without wastage of film.** The inputs to the computer (31) are of aircraft speed (17) and altitude (18), percentage overlap (19) between successive pictures, and lens angle (5). These are used to calculate for each camera the interval between exposures, which is stored in a latch circuit (32) and displayed by indicator (6). Start and stop buttons (22) and (23) control an interval timer (33) which through gate (34), amplifier (35), and shutter circuit (36) effects the operation of the shutter at intervals determined by the value stored in latch (32). Facilities are also described for transcribing reference data onto the film." *E.g.*, EX1005 (**Fujimoto**), Abstract.

191. Fujimoto further expressly discloses that its computerized system provides independent control of systems having multiple still cameras (*e.g.*, "four cameras"), such as Loewen's system (as discussed below with respect to the requirements of, *e.g.*, claims 20, 21, 26, and 27, each of which require three image-capturing devices): "**Referring to Figure 2 the reference numerals 1, 2, 3 and 4**

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designate a first block, a second block, a third block and a fourth block, respectively, each of which accommodates an aerial camera. This means that the illustrated control system can control four cameras. In addition to the camera, each block is provided with a digital switch 5 for setting and indicating the lens angle, a digital display 6 for indicating the interval (second) calculated by the computer, a digital display 7 for indicating the time (seconds) remaining before starting photo-taking, a camera operation switch 8, a digital switch 9 for setting the number of exposures to be photographed in, a digital display 10 for indicating the number of unphotographed exposures counted down from the set number, a press button 11 for presetting the set value of the digital switch 9 to a down-counter, a digital switch 12 for setting the number of exposures to have been photographed in by the previous day, a digital display 13 for indicating the total number of exposures which have been photographed in as of that day, and a press button 14 for presetting the set value of the digital switch 12 to an up-counter." *E.g.*, EX1005 (**Fujimoto**), ¶0008; *see also, e.g.*, *id.*, Fig. 2:

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192. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed computer system that transmits image-capture signals to the first image-capturing device and the second image-capturing device to cause the first and second image-capturing devices to capture images using Fujimoto's advantageous teachings of using separate controls for multiple image-capturing devices.** POSITA would have recognized that doing so would advantageously prevent capturing wholly or partially unnecessary and/or duplicative images that would be captured by simultaneous triggering of both cameras, thus reducing the storage space used by the system, advantageously increasing the number of structures that can be captured by the combined system, and reducing the need to process unnecessary and/or duplicative data. Indeed, although not required for

obviousness, Fujimoto expressly teaches that independent camera control beneficially avoids "waste of film." *E.g.*, EX1005 (**Fujimoto**), ¶¶0003, 0004. Applying this teaching of Fujimoto to the digital context of Loewen's system, POSITA would have recognized that independent camera control beneficially avoids waste of memory/storage. Reducing duplicative imagery (and the resulting waste of storage space) would also enable the capture of higher-resolution images (which require more storage than lower-resolution images, and which Loewen expressly discloses are advantageous, *e.g.*, EX1004 (**Loewen**), 2:30-64, 11:47-51), thereby enabling the combined system to provide more detail of captured structures or other capture objectives, and enabling the devotion of more system resources to analyzing such images (rather than, *e.g.*, unnecessary and/or duplicative data), increasing the usefulness of such imagery by allowing a user to discern more information from such images. Additionally, in my opinion, POSITA would have recognized that controlling both cameras independently would advantageously account for the different capture timing requirements and overlap rates that would arise in a multi-camera image capture system that employs cameras with different resolutions, or employs cameras arranged to capture different oblique angles or a mix of oblique and orthogonal angles. This would allow POSITA to efficiently capture additional usable information not available if the cameras were triggered together. Further, in my opinion, POSITA would have recognized that allowing for greater control of

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camera timing could beneficially account for situations where one camera's view could be at least partially obscured if it were triggered together with another camera or cameras. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with reasonable expectation of success.

193. In my opinion, this and other combinations described herein are implemented in well-understood, wholly predictable technology (*e.g.*, hardware and software), further underscoring POSITA's reasonable expectation of success for each combination. As '657 itself acknowledges, hardware capable of implementing the '657 patent's claims was already known to POSITA. EX1001, 4:23-35 ("Image-capturing devices… for example, conventional cameras, digital cameras, digital sensors… or other suitable image-capturing devices" that have "**known** characteristics"), 4:55-58 ("INU is a **conventional** inertial navigation unit"), 5:6-26, 5:27-47 ("image-capturing computer system… for example, a **conventional** laptop personal computer"); *see also*, *e.g.*, EX1004 (**Loewen**), 6:44-51 ("**conventional** firewire connections"), 7:20-22 ("onboard computer receives and sends out all its required signals via **conventional** RS-232 ports"), 7:56-58 ("trigger system 74 in the preferred embodiment is a laser altimeter, a **conventional and commercially available** device"), 8:35-46 ("**conventional** programming techniques").

* * *

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194. Thus, in my opinion, Loewen in view of Fujimoto renders obvious this limitation.

195. Accordingly, in my opinion, claim 1 is rendered obvious over Loewen in view of Fujimoto.

D. Claim 3 Is Rendered Obvious Over Loewen in View of Fujimoto Garrot, and Mostafa (Ground 2)

196. **In my opinion, claim 3 is rendered obvious over Loewen in view of Fujimoto, Mostafa, and Garrot (Ground 2).** *See infra*, Appendix C, Claim 3.

1. Element 3.pre (the preamble of claim 3)[18]

197. Claim 3.pre recites "**The system of claim 1, wherein said at least one geo-locating device and said at least one geo-locating signal respectively comprise.**" **In my opinion, Loewen in view of Fujimoto renders obvious this limitation.**

198. In my opinion, **Loewen in view of Fujimoto renders obvious the system of claim 1 and includes at least one geo-locating device and said at least one geo-locating signal respectively comprise** (*see* cl.1). The particular geo-locating device and geo-locating signals of the remainder of claim 3 are discussed below.

[18] To the extent deemed limiting, the preamble is disclosed.

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2. Element 3.a

199. Claim 3.a recites "a clock issuing to said image-capturing computer system time data signals indicative of a time of each said image-capturing event." **In my opinion, Loewen discloses or renders obvious this limitation.**

200. In my opinion, **Loewen discloses a clock issuing to said image-capturing computer system time data signals indicative of a time of each said image-capturing event;** (*e.g.*, "During the camera trip[19] the computer program records the time and location of the trip into a separate file for post processing of the images."; "the program records the time of the [camera] trip along with the geographic longitude/latitude coordinates of that tower location")**.**

201. As an initial matter, I note that Loewen expressly discloses its system "records the time" of the "camera trip" into a "separate file," and thus expressly discloses transmitting a time data signal from the clock to the separate data file. EX1004 (**Loewen**), 9:29-31. POSITA would have understood that Loewen thus discloses that the "time" stored in this file is indicative of a geo-location of Loewen's image-capturing devices at each image-capturing event because the time of the

[19] *I.e.*, during the "tripping" of the camera's shutter to capture an image. *See, e.g.*, EX1004 (**Loewen**), 6:51-58.

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camera trip is recorded alongside the longitude/latitude coordinates of the image captured at that time.

202. For example, Loewen discloses recording a "time stamp" at which images are taken: "A laser survey module (i.e., terrain mapping) has the computer recording all the GPS data strings as well as continuous laser readings 91 into a text file. **This file also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower the same as was described above in connection with the video survey module.**" *E.g.*, EX1004 (**Loewen**), 8:65-9:5.

203. Loewen further discloses associating its geo-locating signals with its image-data signals, including Loewen's time signals: "[i]n the GPS camera trip mode (FIG. 9), the GPS camera trip software module requires that the computer be given the latitude/longitude location of every tower that is to be filmed. The computer then steadily calculates the distance from a last GPS reading at 95 the last tower encountered to the first tower location to be encountered after that last tower GPS reading. The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., arrive at a particular desired exposure point for the still cameras a predetermined distance past the tower. The programming allows for varying the preselected distance, and thus the exposure point, as required or desired. The system

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is reset 101 with the next trip location being loaded into the computer and the camera trip program starts over again. **During the camera trip the computer program records the time and location of the trip into a separate file for post processing of the images.**" *E.g.*, EX1004 (**Loewen**), 9:14-31; 9:6-13 ("The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude. With the appropriate software programming as mentioned above, the system is capable of embedding the longitude/latitude coordinates for either the video output or the still camera output. That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association with the image of a particular tower."), 9:32-39 ("The laser altimeter trip software module has the computer responding to the input from the laser altimeter signifying the laser altimeter has identified a tower structure. The program then calculates, using the ground speed, to apply the proper time delay to trigger the still cameras at the desired exposure point. Again **the program records the time of the trip along with the geographic longitude/latitude coordinates of that tower location.**" *E.g.*, EX1004 (**Loewen**), 9:32-39.

204. Loewen explains that the contents of this file are used during "post processing of the images" at which point Loewen's computer system "coordinate[s] the captured images with the original trip file containing the tower locations" (which also contains other geo-locating information such as time and continuous readings

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from the laser altimeter, *e.g.*, EX1004 (**Loewen**), 8:65-9:5) to, *e.g.*, "label all images" with such data (which includes time data from Loewen's clock). *E.g.*, EX1004 (**Loewen**), 9:40-45.

205. To the extent it is argued further disclosure of a clock is required, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with a GPS-detected location indicative at least in part of a geo-location of each of a first and second associated image capturing device (in the combined Loewen-Fujimoto system, *see* cl.1.f) using a clock (which was a well-known component of image-capturing systems, *see, e.g.*, EX1005 (Fujimoto), ¶¶9 ("electronic clock"), 17 ("electronic clock 40 includes a clock pulse generator")), issuing to Loewen's computer system time data signals indicative of a time of each image-capturing event.** POSITA would have recognized that doing so would have advantageously provided additional data, which would have been beneficial because it would add further precision to the georeferencing performed in Loewen. Additionally, POSITA would have recognized that including time data signals from a clock indicative of a time of each image-capturing event would have advantageously provided information about the time of day at which an image was captured (and would have been consistent with Loewen's express discussions of its system's use of time data (*e.g.*, EX1004

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(**Loewen**), Abstract ("The central processing unit calculates the ***time delay*** necessary for said aircraft to fly past the tower…."), 4:26-30 ("The onboard computer, based on the ground speed of the aircraft, determines the ***time*** necessary for the aircraft to fly from the point of receiving the signal past the detected tower a distance corresponding to the exposure point relative to the tower."), 6:54-57 ("As will be described more completely hereinafter, the ***actual trip time*** is calculated either by using a GPS location and known structure locations, or by using a laser altimeter."), 9:29-31 ("During the camera trip the computer program records the ***time*** and location of the trip….")), increasing the usability of such images and efficiency of the system by, *e.g.*, providing the ability for users to ascertain the time at which an image was taken to better track and inventory the status of inspected power lines and towers and the state of rights-of-way (including comparisons over time at, *e.g.*, the same time of day) and, in the case of images taken with low visibility due to poor lighting conditions at a particular time of day, to permit scheduling future image-capturing flights to avoid that time of day. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

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206. Thus, in my opinion, Loewen discloses or at minimum renders obvious this limitation.

3. Element 3.b

207. Claim 3.b recites "**a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second image-capturing devices at each said image-capturing event.**" **In my opinion, Loewen discloses this limitation.**

208. In my opinion, **Loewen discloses a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second image-capturing devices at each said image capturing event;** (*see* cl.1.c (mapping Loewen's "GPS"))**.**

* * *

209. Thus, in my opinion, Loewen discloses this limitation.

4. Element 3.c

210. Claim 3.c recites "**an inertial navigation unit (INU) issuing to said image-capturing computer system velocity data signals indicative of a velocity of said first or second image-capturing device at each said image-capturing**

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event." In my opinion, Loewen in view of Mostafa renders obvious this limitation.

211. In my opinion, **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c)**.**

212. In my opinion, **Mostafa discloses an inertial navigation unit (INU) issuing velocity data signals indicative of a velocity of image-capturing devices at image-capturing events** (*e.g.*, "navigation data is collected using a Honeywell LRF III inertial navigation system"; "The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft.") to an image-capturing computer system.

213. First, Mostafa expressly discloses **an inertial navigation unit** (INU). For example, Mostafa discloses: "**The configuration shown in Fig. 2 acquires two separate streams of data, namely, the navigation and the imaging data. The navigation data is collected using a Honeywell LRF III inertial navigation system, and an Ashtech ZXII GPS receiver, connected to a portable computer for raw data acquisition and storage for subsequent post-mission processing.** The image data is collected by two low-cost Kodak DCS420c digital cameras equipped with a 1.5=1 K CCD chip (9 mm pixel resolution). **To synchronize the**

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INS, GPS, and image data in a common time frame, the INS records are stamped in real-time by the Ashtech GPS receiver PPS (pulse per second) signal, while a Trimble GPS receiver event marker pulse is used to store the instant of time when an image is captured by one of the cameras. Therefore, all the data are synchronized in the GPS time frame during data logging. The data acquisition is controlled by a real-time data logging software which downloads the GPS/INS/imagery data to the host computers, and time tags the imagery and INS records by the GPS receiver-derived time pulse." *E.g.*, EX1007 (**Mostafa**), 3-4, Fig. 2 (annotated):

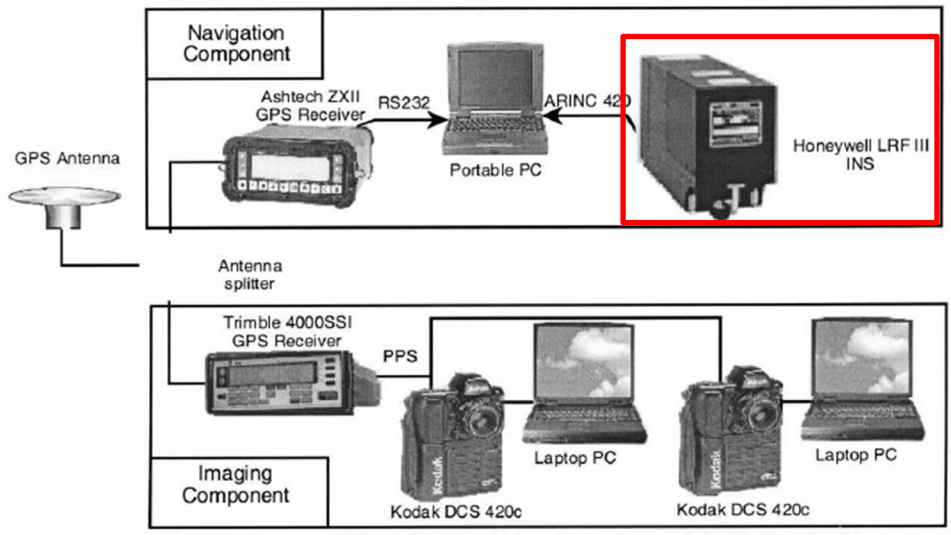


Fig. 2. Hardware configuration.

214. Second, Mostafa discloses its **INU issues data signals indicative of a velocity of image-capturing devices at image-capturing events**, explaining that "an airborne fully digital multi-sensor system for digital mapping data acquisition is presented. **The system acquires two streams of data, namely, navigation**

(georeferencing) data and imaging data. The navigation data are obtained by integrating an accurate strapdown inertial navigation system with a differential GPS system (DGPS). The imaging data are acquired by two low-cost digital cameras, configured in such a way so as to reduce their geometric limitations. The two cameras capture strips of overlapping nadir and oblique images. **The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft.** Thus, image exterior orientation information is extracted from the trajectory, during post-processing. This approach eliminates the need for ground control (GCP) when computing 3D positions of objects that appear in the field of view of the system imaging component. Two approaches for calibrating the system are presented, namely, terrestrial calibration and in-flight calibration. Test flights were conducted over the campus of The University of Calgary. Testing the system showed that best ground point positioning accuracy at 1:12,000 average image scale is 0.2 m (RMS) in easting and northing and 0.3 m (RMS) in height. Preliminary results indicate that major applications of such a system in the future are in the field of digital mapping, at scales of 1:5000 and smaller, and in the generation of digital elevation models for engineering applications." *E.g.*, EX1007 (**Mostafa**), Abstract; *see also, e.g.*, EX1007 (**Mostafa**), 9 ("The flight was done with wide turns to avoid signal blockage by aircraft banking and, thus, the roll angle was typically smaller than 158. Further, mission planning was done to ensure a good sun angle and good

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satellite sky distribution. Two master stations were kept running during the test period. One was located close to the airport and was occupied by a Trimble 4000 SSI, the other was on the rooftop of the engineering building and was occupied by an Ashtech Z XII receiver. This resulted in two independent GPS trajectories which, when compared, agreed to be better than 10 cm, which is typical for a 2–8-km baseline. These values indicate that each of the two independent solutions provides sufficiently high-precision camera exposure station position. The Ashtech GPS raw data together with the INS measured specific force and angular velocity raw data were processed using the KINGSPAD software. The Kalman filter-derived estimates of the positioning precision are 0.04, 0.05 and 0.09 m, for latitude, longitude and height, respectively. **For attitude, they are 0.00758, 0.00978 and 0.01528, for roll, pitch and yaw, respectively. The GPS/INS interpolated position and attitude angles at each exposure station were used together with the imagery to analyse the system performance when using nadir plus oblique images. After preprocessing the GPS/INS data to compensate for the position and orientation offsets between the navigation and imaging sensors, the compensated position and attitude parameters were used as observable exterior orientation parameters** (in M-frame) together with their standard deviations and the image point measurements from the commercial software package PCI OrthoEngine."), 12 ("The system developed here is at the prototype level and, thus, data acquisition was

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also implemented at the prototype level. For example, the multi-camera system containing two cameras for testing was implemented using two separate laptops and a GPS receiver to synchronise the acquired imagery to the GPS time frame. In addition, the navigation data was collected using a different host computer with a different GPS receiver. Further, a full inertial system and GPS receivers were used to acquire only the raw data from the IMU and the GPS cards. This significantly adds to the system budget and reduces system portability. **It is, therefore, recommended to design an industrial computer system that can accommodate the necessary boards for simultaneous navigation and image data acquisition. This would greatly improve system portability and cost.** Besides the work presented here, map production using the Kodak DCS series has been reported (cf. Congalton et al), 1998. However, since these cameras are not designed for aerial surveys, the long-term stability of their calibration could be problematic and has to be well studied before using them in mapping."), Figs.1, 5:

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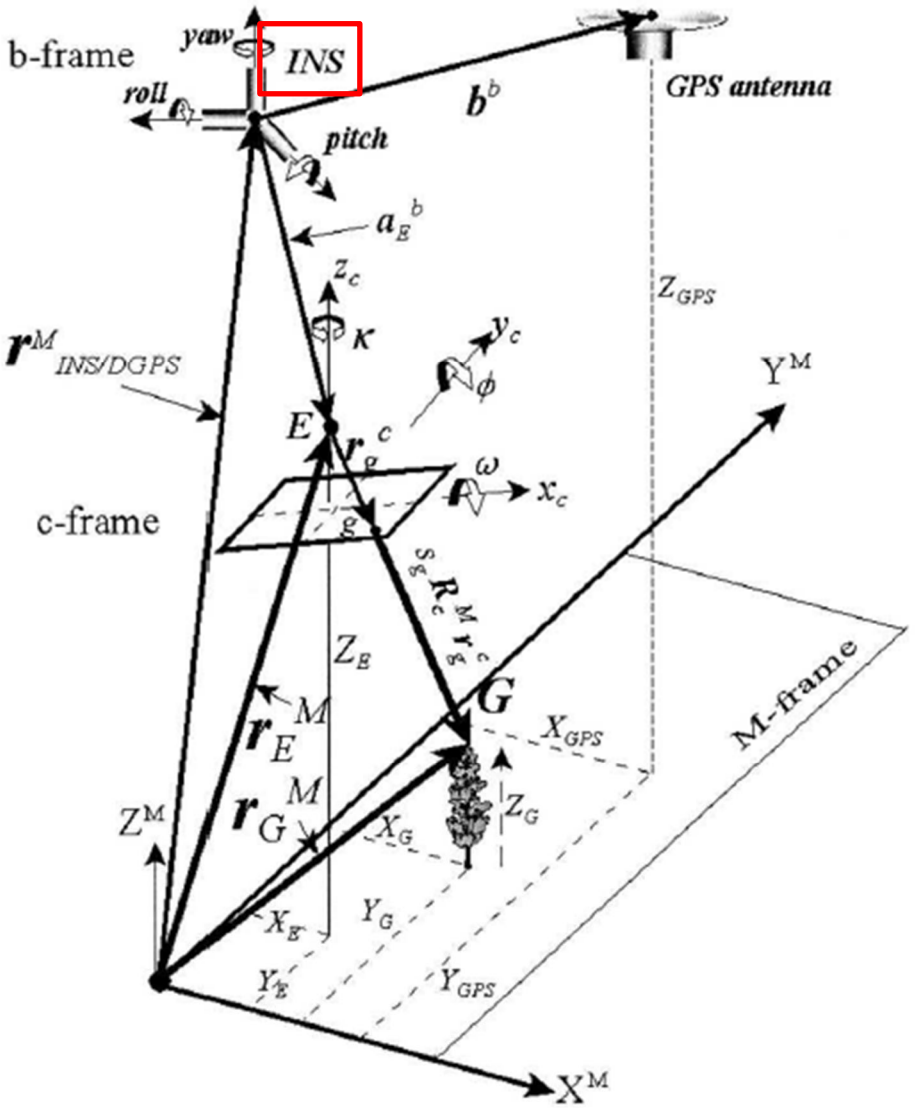


Fig. 1. Elements of direct georeferencing (see explanations in text).

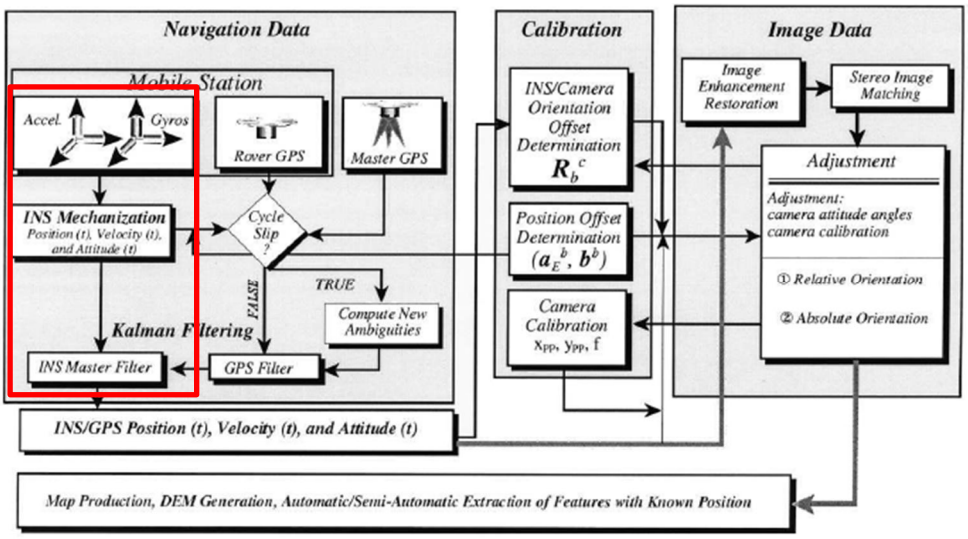


Fig. 5. The multi-sensor system data-flow (in-flight calibration case).

215. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with, *e.g.*, a GPS-detected location indicative at least in part of a geo-location of each of a first and second associated image capturing device and an altimeter indicative of an altitude of a first and second image-capturing device (in the combined Loewen-Fujimoto system, *see* cl.1.f) using Mostafa's advantageous teachings of an inertial navigation unit (INU) (which was a well-known and conventional component of aerial imaging systems (*e.g.*, EX1008 (Kain 1997), 2:29-32 (discussing prior-art "inertial navigation systems")), issuing to an image-capturing computer system velocity data signals indicative of a velocity of image-capturing devices at image-capturing events.** POSITA would have recognized that implementing the combined Loewen-Fujimoto system with this

additional INU input (as taught in Mostafa) would have advantageously increased the system's imagery accuracy and advantageously provided a backup if, for example, during flight contact with the GPS satellite was lost, thus allowing the combined system to continue to track and record the location of its image-capturing devices based on INU data until contact with the GPS satellite was reestablished. Indeed, Mostafa itself expressly describes significant improved ground positioning accuracy when "[u]sing GPS/INS-aided" imagery. *E.g.*, EX1007 at 11 (noting oblique imagery with GPS/INS-aided block triangulation with nadir imagery "improved the ground positioning accuracy to 0.2m in planimetry (1σ) and 0.3m in height" compared to 0.5m planimetry and a height accuracy of 0.7m when using only a nadir stereopair and an extra oblique). Moreover, Fujimoto (which is part of the combined Loewen-Fujimoto system, see cl.1.f) expressly discloses the use of "speed of flight" and a "speedometer" (EX1005 (**Fujimoto**), ¶0006, ¶0013), further showing that incorporating velocity information would have been understood by POSITA to be routine and beneficial. Further, POSITA would have recognized that adding additional sensors including an INS—as well as, for example, a compass, and gyroscope (discussed below), would have been beneficial because doing so would add further precision to the georeferencing performed in the combined Loewen-Fujimoto system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work,

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predictably yielding the expected functionality with reasonable expectation of success.

* * *

216. Thus, in my opinion, Loewen in view of Mostafa renders obvious this limitation.

5. Element 3.d

217. Claim 3.d recites "**a gyroscope issuing to said image-capturing computer system a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of said first or second image-capturing device at each said image-capturing event.**" **In my opinion, Loewen in view of Garrot renders obvious this limitation.**

218. In my opinion, **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c)**.**

219. In my opinion, **Garrot discloses a gyroscope issuing a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of image-capturing devices at image-capturing events;** (*e.g.*, "For each image event this file contains:… 5. Gyro pitch; 6. Gyro roll"; "pitch, roll, yaw") to a computer**.**

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220. First, Garrot expressly discloses **a gyroscope**. For example, Garrott discloses: "In a specific embodiment the sensor is an infrared sensor and the system for georeferencing the acquired signals is a receiver adapted to receive signals from a global positioning system. **In the specific embodiment, the means for compensating for tilt in the aircraft includes a vertical gyroscope, a magnetometer and software for controlling the gyroscope by a dedicated processor to produce signals indicative of the orientation of the aircraft. The software compensates for tilt in the acquired signals and uses the GPS signals, vertical gyroscope, magnetometer, and imaging constants to create an accurate mosaic of the images generated by the sensor.**" *E.g.*, EX1006 (**Garrot**), 4:66-5:9; *see also, e.g.*, EX1006 (**Garrot**), 10:61-11:18 ("**In the preferred embodiment, the gyro 26 is a Humphry's Instrument model # VG24-3116-1 vertical gyro.** It is mounted directly to the imager housing's mounting bracket. This device contains a 2 axis (pitch, roll) rotating gimbaled gyro element and a vertical erection system that actively seeks the vertical gravity vector. The erection system is disabled during sustained turns and accelerations automatically by the dedicated acceleration processor 50. A control panel 52 provides visual indication of the gyro status and includes override switches that can manually control the gyro. The magnetometer 24 is a TCM2-16 manufactured by Precision Navigation Inc. which is a solid state device. This device measures the earth's X, Y, and Z magnetic fields relative to the

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imaging platform. This data is used in conjunction with the vertical gyro's pitch and roll data taken concurrently to derive vehicle heading. This is an important feature, because in the inventive system, heading is essentially immune to vehicle accelerations. Heading values calculated from a magnetic sensing device depend upon accurate vertical inclination (pitch and roll values) at all times. Conventional sensors use an inexpensive on-board inclinometer which is useless on a dynamic platform such as an aircraft. The magnetometer sensor is oriented such that its pitch and roll planes align with the gyro's 26 pitch and roll axes."), Figs.1, 8C:

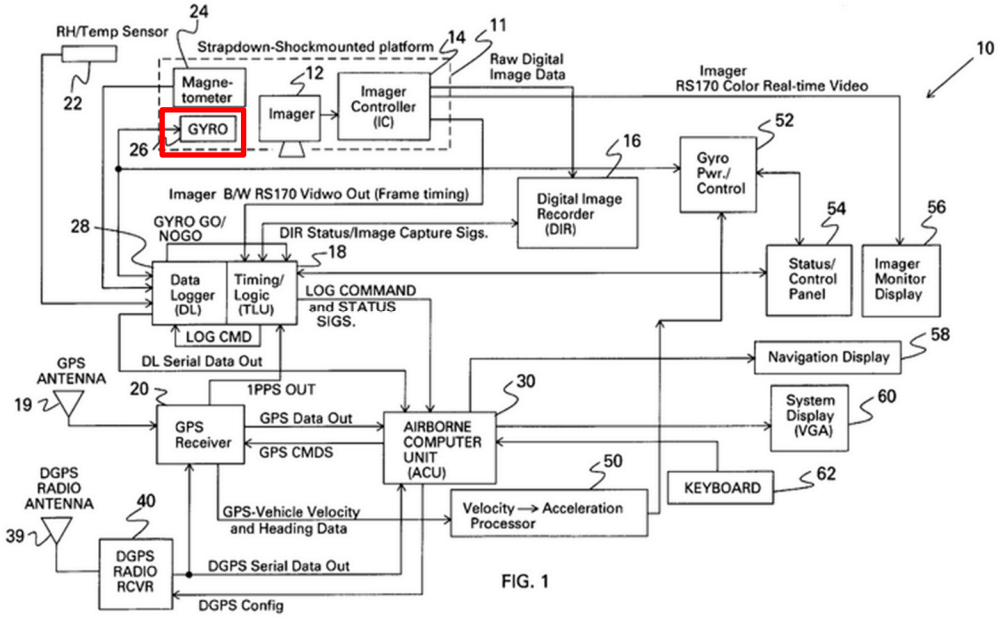


FIG. 1

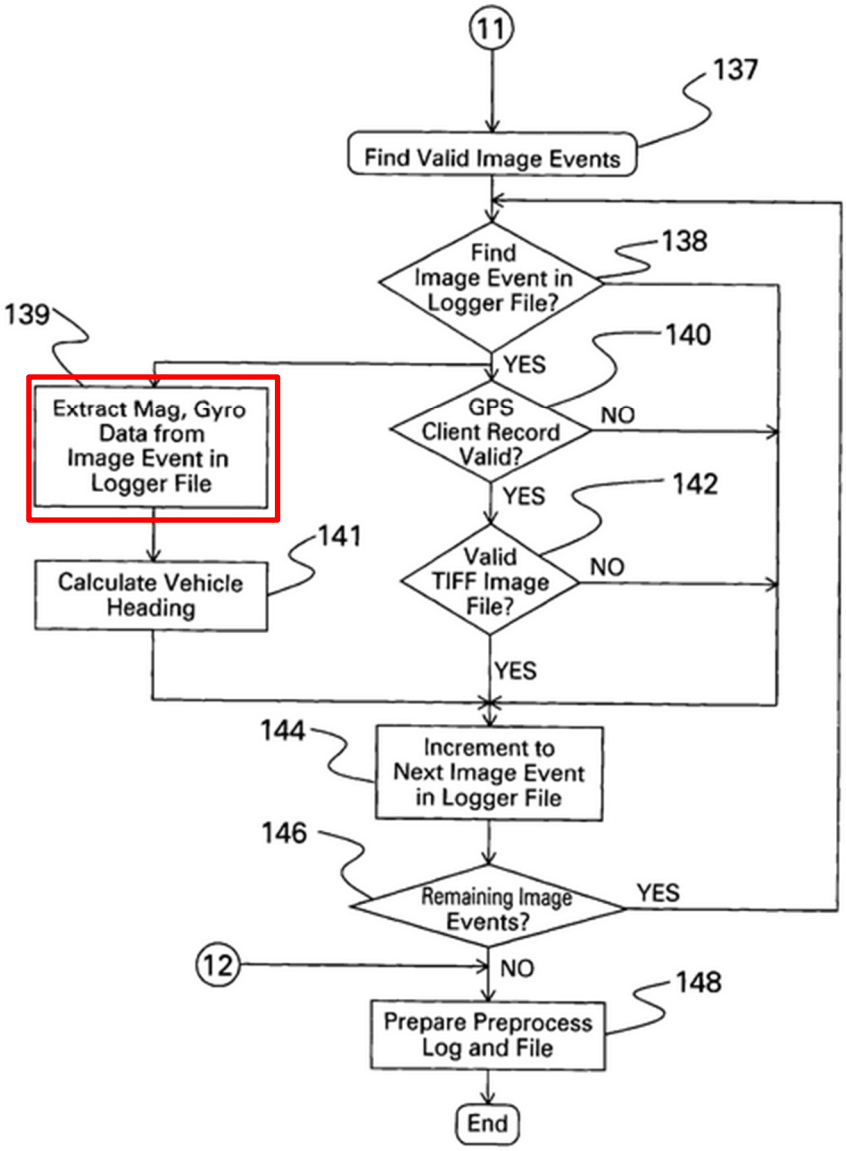


FIG. 8C

221. Second, Garrot discloses that its gyroscope (*e.g.*, "gyro") issues to Garrot's imaging system **a pitch signal, roll signal, and yaw signal respectively indicative of a pitch, roll, and yaw**: "**The Imaging Platform (IC) 11 contains the imager 12, gyro 26, magnetometer 24, and imager controller 14.** The IC is a rigid platform that is mounted to the aircraft via vibration isolated mounts. **The gyro and**

magnetometer are rigidly attached to the platform, as is the imager. Any relative motion (pitch, roll, yaw) that the imager experiences, will also be sensed by the gyro and magnetometer." *E.g.*, EX1006 (**Garrot**), 10:25-32; *see also, e.g.*, EX1006 (**Garrot**), 6:14-47 ("FIG. 1 is a block diagram of the imaging system 10 of the present invention. The inventive imaging system 10 collects and stores the necessary image, environmental, GPS, magnetic, inertial and timing data required to enable the Post Processing Program (described below) to produce high resolution, georeferenced imagery. The imaging system 10 is located on an aircraft or other airborne vehicle (not shown). In the illustrative embodiment, the system includes an infrared imager 12. Nonetheless, the teachings of the present invention may be applied to other types of imagers without departing from the scope thereof. The imager 12 is mounted on an image platform (IP) 11 within the aircraft such that the imager 12 is looking down at the target area. As the aircraft flies over a target area, the system 10 acquires discrete digital images that, in accordance with the present teachings, are subsequently mosaicked to produce the desired output image. As the aircraft flies a prescribed grid pattern to collect imagery representing the entire target area, the imager 12 acquires long wave radiographic infrared digital images. In addition, the imaging system 10 provides real-time navigation and system status information to the pilot and flight technician. A Global Positioning System (GPS) receiver 20 outputs precision position, velocity, and timing information. **A vertical**

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gyroscope (gyro) 26 and magnetometer 24 which are hard mounted to the IP provide the imaging platform's pitch, roll, and heading data. Control of the vertical gyro 26 is aided by velocity and heading information from the GPS receiver 20 directed to a dedicated processor 50. The processor 50 calculates a smoothed acceleration and controls the erection mechanism of the gyro 26, yielding more accurate pitch and roll data. This information combined with the GPS data provides real-time georeferencing information which is logged during the flight session."), 6:48-7:12 ("In operation, the imaging system 10 collects digital imagery at specified intervals depending upon the flight altitude and aircraft speed. Imagery is collected within the flight zone, and is automatically disabled when outside of the flight zone or in a turn. An Airborne Computer Unit (ACU) 30 produces an image strobe command. This command is received by a Timing and Logic Unit (TLU) 18 and a corresponding signal is sent to a Digital Image Recorder (DIR) 16 just before the desired image frame. Digital image frames are constantly streaming into the DIR 16 from an Imager Controller Unit (ICU) 14 associated with the imager 12. This signal is optionally inhibited during a no-go condition (such as in a turn) produced by the continuous monitoring of the GPS Receiver 20 by the dedicated processor 50. The DIR responds by signaling the TLU that it is ready to record the next incoming digital image frame. The TLU monitors the analog video output from the imager which is synchronized to the digital image data, and extracts

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timing pulses from the video signal. The TLU sends a logger strobe pulse to a Data Logger Unit (DLU) 28 and to the ACU precisely in the middle of the next frame. The ACU time tags the logger strobe pulse, which is used to interpolate a position and altitude corresponding to the image capture event. **The DLU receives the pulse and immediately samples the gyro 26, magnetometer 24, and RH/Temperature sensors 22 and outputs this information via serial link to the ACU where it is time-stamped and logged to disk.** Meanwhile, the DIR logs the desired image to its separate disk via a locally time tagged image file. The RH/Temperature sensors 22 serve to measure canopy air temperature differential and acquire relative humidity (RH) to calculate Vapor Pressure Defficit over the crop area.").

222. Third, Garrot expressly discloses that its gyro generates **signals indicative of, *e.g.*, a pitch and roll of the image-capturing device at each said image-capturing event**. For example, Garrot discloses: "**Vehicle acceleration is calculated by the dedicated processor 50 for the purpose of controlling the erection mechanism of the vertical gyro 26. As mentioned above, the vertical gyro 26 resides on the imaging platform 11 and produces pitch and roll data needed for an accurate projection of each logged image frame.** The processor 50 consists of an embedded computer that receives GPS velocity, heading, time, and solution status information from the GPS receiver 20 at a 5 Hertz rate via a serial data link. The processor 50 controls the vertical gyroscope's 26 erection mechanism.

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FIG. 1A is a flow diagram of an illustrative implementation of software running on the acceleration processor. As shown in FIG. 1A, upon initial power-up, the processor reads in a configuration file, initializes all internal settings 100, the GPS data communications (COM) port 104, and resets the output pins 102. The output pins control the vertical gyroscope 26 and a status light that indicates the GPS solution status bit condition. When the GPS receiver 20 indicates that satellite tracking is occurring such that reliable GPS data is produced, the input serial data is assumed to be valid 106 and the GPS Data Valid pin 108 is asserted. Instantaneous Normal (roll) and axial (pitch) accelerations 110 are calculated and a second order digital filter 112 at a cut-off frequency of 0.5 Hz. is applied to each axis, and compared to an acceleration threshold 114 by processor 50. When the value in either axis is exceeded, the gyro is commanded to a free inertial state 116, otherwise the normal erection mechanism is active. Greatly smoothed pitch and roll data are produced because less of the vehicle accelerations influence the vertical gyro readings facilitating better image quality than is possible with an un-aided vertical gyro. The vertical gyro 26 contains an erection system that slowly seeks the gravity vector. The gravity vector is influenced by instantaneous and sustained accelerations. The gyro's pitch and roll readings will contain erroneous values if these accelerations are allowed to accumulate. The purpose of the processor 50 is to minimize the accelerations that can influence the vertical gyro by temporarily

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commanding the gyro into a free erection state (insensitive to any accelerations) during a GPS measured acceleration period which exceeds the predefined threshold. This cycle will repeat itself many times during a flight." *E.g.*, EX1006 (**Garrot**), 8:18-60.

223. Garrot further discloses that for "each image event" (which corresponds to an image-capturing event as required by the '657 patent) an associated file contains both "gyro pitch" and "gyro roll": "4. Find all valid image events for the survey session (step 137). Repeat steps 1 and 2 above and look (step 138) for digital input word "249" in the *.MK5 record, then (step 140) find the valid *.CLI record as depicted in 2 above. If found, then find the corresponding valid TIFF Image file (step 142) as depicted in 1 above. Continue (step 144) to search for all image events and form valid associations until all are accounted for (step 146). Extract all necessary data from the *.MK5 and *.CLI records and write it to the PREPROC.AP3 file (step 148). Each valid image event will occupy one full record in the PREPROC.AP3 file. This is a binary file. All relevant data contained in the various AP3 input files are combined into a single file called PREPROC.AP3. **For each image event this file contains:**

1. GPS time
2. UTMNorthing of aircraft GPS antenna
3. UTM Easting of aircraft GPS antenna
4. Geoid height of the aircraft GPS antenna (altitude)
5. Gyro pitch

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6. Gyro roll
7. Imager 12 pitch (not shown)
8. Imager 12 roll (not shown)
9. Heading (derived from magnetometer 24 or compass (not shown))
10. Corresponding TIF image file from DIR 16 associated with the image event.

Heading is computed by extracting the magnetometer X, Y, and Z values from the datalogger record (step 139), applying the offsets entered in the preprocessing window in AP3 (see FIG. 6) to the magnetometer values, and combining Gyro Pitch and Gyro Roll and calculating heading (step 141). The algorithm that is used determines the attitude of the magnetometer (pitch, roll) and then calculates heading based upon the magnetometer values. The vector G which is true vertical is determined, and then the directional vector N which is magnetic north is calculated. The vector H which is vehicle heading relative to directional vector N is determined and entered as heading into the PREPROC.AP3 record (step 148)." *E.g.*, EX1006 (**Garrot**), 19:35-20:7.

224. With respect to the combination of Loewen and Garrot, Garrot's system, like Loewen's, stores its geo-locating data in its computer system, thus supporting motivation to combine and reasonable expectation of success, discussed below. Garrot further discloses that its system records signals from its gyroscope in a data file, and thus (like Loewen) that Garrot's computer system stores Garrot's geo-locating signals: "The Data Logger Unit's (DLU) 28 serial data *.GR5 file is

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combined with its $ character time stamps file *.CH5 to create an ASCII file *.MK5. MK5 stands for "marked" data file from serial port #5 of the ACU 30. In the system 10 of FIG. 1, the Data Logger Unit 28 samples the vertical gyro analog output, the MET sensor's analog output, the Imager's inclinometer's analog output (not shown), digital status inputs/outputs, and the magnetometer 24 serial output. All of the analog inputs are converted to engineering units and this data is output in a formatted structure. A sample *.MK5 file is shown below." *E.g.*, EX1006 (**Garrot**), 15:30-40.

225. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with a GPS-detected locations indicative at least in part of a geo-location of each of a first and second associated image capturing device (in the combined Loewen-Fujimoto-Mostafa system, *see* cl.1.f, cl.3.c) using Garrot's advantageous teachings of a gyroscope issuing to an image-capturing computer system a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of image-capturing devices at each said image-capturing event.** POSITA would have recognized that implementing the combined Loewen-Fujimoto-Mostafa system with these additional gyroscope signals (as taught in Garrot) would advantageously permit POSITA to record more accurately the system's heading as

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it captured imagery in order to derive more accurate georeferenced imagery. Indeed, Garrot discloses using a gyroscope "yielding more accurate pitch and roll data" which can be "combined with the GPS data [to] provide[] real-time georeferencing information," which Garrot system uses "to produce high resolution, georeferenced imagery." *E.g.*, EX1006 (**Garrot**), 6:14-47. Further, POSITA would have recognized that adding additional sensors, for example, a gyroscope, along with, *e.g.*, an INS and compass, would have been beneficial because doing so would add further precision to the georeferencing performed in the combined Loewen-Fujimoto-Mostafa system by associating an additional type of geo-locating data with the image-data signals captured by the system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

226. Thus, in my opinion, Loewen in view of Garrot renders obvious this limitation.

6. Element 3.e

227. Claim 3.e recites "**a compass issuing to said image-capturing computer system heading data signals indicative of a heading of said first or**

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second image-capturing device at each said image-capturing event." **In my opinion, Loewen in view of Garrot renders obvious this limitation.**

228. In my opinion, **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c)**.**

229. In my opinion, **Garrot discloses a compass** (*e.g.*, "compass") **issuing heading data signals indicative of a heading** (*e.g.*, "raw input files of… compass" from which "Heading" is "derived"") **of an image-capturing device at image-capturing events** (*e.g.*, "For each image event this file contains… Heading (derived from… compass)") to a computer.

230. First, Garrot expressly discloses **a <u>compass</u>**. For example, Garrot discloses: "This section discloses the processing flow used to produce the digital mosaicked images in accordance with the teachings of the present invention. The post flight data processing flow is depicted in FIG. 3. **The input data includes…** the raw input files of a digital magnetometer and **compass (for backup purposes to derive heading).**" *E.g.*, EX1006 (**Garrot**), 12:20-37.

231. Second, Garrot discloses a compass issuing data signals indicative of a heading of an image-capturing device (*i.e.*, "[h]eading") at each said image-capturing event (*i.e.*, image strobe event): "GPS time stamps of each of the image

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strobe events is contained in the *.CT5 file where CT5 stands for serial port #5 of ACU 30 on the CT pin. **Every time an image is acquired, HPC time stamps it with a GPS time.** Also, serial data output from the Data Logger Unit (DLU) 28 is time tagged every time a $ character is encountered and stored in the *.CH5 file. The $ character appears as the first character in the DLU's ASCII serial output every time an image event or meteorological (MET) event occurs. **This file is later combined with the Data Logger Unit's serial data output to form a time stamped file which contains logger data and a GPS time for this event. A file containing optional magnetometer or compass data (*.CH3, and *.CH1 respectively) is stored and later processed in the same manner as the DLU's file *.CH5.** The ch suffix stands for "character" and the number that follows is the serial port ID known to HPC. All of these are binary files and are produced by the HPC software program." *E.g.*, EX1006 (**Garrot**), 13:34-51.

232. Garrot further discloses a compass with heading data signals indicative of a heading of its image-capturing device at each image-capturing event: "4. Find all valid image events for the survey session (step 137). Repeat steps 1 and 2 above and look (step 138) for digital input word "249" in the *.MK5 record, then (step 140) find the valid *.CLI record as depicted in 2 above. If found, then find the corresponding valid TIFF Image file (step 142) as depicted in 1 above. Continue (step 144) to search for all image events and form valid associations until all are

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accounted for (step 146). Extract all necessary data from the *.MK5 and *.CLI records and write it to the PREPROC.AP3 file (step 148). Each valid image event will occupy one full record in the PREPROC.AP3 file. This is a binary file. All relevant data contained in the various AP3 input files are combined into a single file called PREPROC.AP3. **For each image event this file contains:**

1. GPS time
2. UTMNorthing of aircraft GPS antenna
3. UTM Easting of aircraft GPS antenna
4. Geoid height of the aircraft GPS antenna (altitude)
5. Gyro pitch
6. Gyro roll
7. Imager 12 pitch (not shown)
8. Imager 12 roll (not shown)
9. Heading (derived from magnetometer 24 or compass (not shown))
10. Corresponding TIF image file from DIR 16 associated with the image event."

E.g., EX1006 (**Garrot**), 19:35-61.

233. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with a GPS-detected locations indicative at least in part of a geo-location of each of a first and second associated image capturing device using Garrot's advantageous teachings of using a compass to provide an image-capturing computer system heading data signals indicative of a heading** (where that

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heading is also of an image-capturing device at image-capturing events). POSITA would have recognized that implementing the combined Loewen-Fujimoto-Mostafa-Garrot system with this additional compass input (as taught in Garrot) would have advantageously permitted POSITA to record more accurately the system's heading as it captured imagery in order to derive more accurate georeferenced imagery. Indeed, Garrot discloses using a compass to derive a heading which can be "combined with the GPS data [to] provide[] real-time georeferencing information," which Garrot's system uses "to produce high resolution, georeferenced imagery." *E.g.*, EX1006 (**Garrot**), 6:14-47. Further, POSITA would have recognized that adding additional sensors, for example, a compass, along with an INS and gyroscope, would have been beneficial because it would add further precision to the georeferencing performed in the combined Loewen-Fujimoto-Mostafa-Garrot system by associating an additional type of geo-locating data with the image-data signals captured by the system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

234. Thus, in my opinion, Loewen in view of Garrot renders obvious this limitation.

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7. Element 3.f

235. Claim 3.f recites "**an altimeter issuing to said image-capturing computer system altitude data signals indicative of an altitude of said first or second image-capturing device at each said image-capturing event.**" **In my opinion, Loewen discloses this limitation.**

236. In my opinion, **Loewen discloses an altimeter issuing to said image-capturing computer system altitude data signals indicative of an altitude of said first or second image-capturing device at each said image-capturing event** (*e.g.*, "the laser altimeter 74 will detect the passage of the aircraft over a tower structure and generate a signal"; "laser altimeter detects the major difference in height of the aircraft above a tower… [and] generates a signal in response to that difference which is transmitted to the onboard computer"; "laser survey module… has the computer recoding… continuous laser readings into a text file… [which] also contains the time stamp of the time when the laser altimeter located a transmission tower structure"; *see* cl.1.e)**.**

237. First, POSITA would have understood Loewen discloses an **altimeter** ("laser altimeter") **issuing altitude data signals indicative of an altitude of a first or second image-capturing device** (including the first camera) **at each image-capturing event**. For example, as Loewen expressly discloses, its "laser altimeter" "is capable of determining the height of the aircraft above the terrain," as well as

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"the major difference in height of the aircraft above a tower as compared to the height of the aircraft above the terrain" (*e.g.*, EX1004 (**Loewen**), 8:21-31), and the "laser altimeter… can be supported on the outer housing of the pod" (*e.g.*, EX1004 (**Loewen**), 8:15-16), which Loewen expressly discloses houses Loewen's image-capturing devices (*e.g.*, EX1004 (**Loewen**), 5:62-64), and thus POSITA would have understood that the altitude determined by the laser altimeter to be indicative of the altitude of Loewen's aircraft or pod, and thus Loewen's image-capturing devices housed within the pod. Moreover, as Loewen expressly discloses, "the laser altimeter generates a signal in response to" sensing a "difference in height of the aircraft above a tower," and this "signal… is transmitted to the onboard computer establishing the fact that the aircraft has passed over a tower" such that an image should be captured (*e.g.*, EX1004 (**Loewen**), 8:31-34), and thus POSITA would have further understood that the altitude data signals are indicative of an altitude of Loewen's image-capturing devices *at each image-capturing event* because the altitude detected by Loewen's laser altimeter is used by Loewen's computer system to trigger Loewen's image capturing devices, and thus is the altitude of Loewen's image-capturing devices at such image-capturing events. *E.g.*, EX1004 (**Loewen**), 8:65-9:37 ("recording… continuous laser readings 91 into a text file… file also contains the time stamp of the time when the laser altimeter located a transmission

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tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower"), 10:14-16, 10:30-34, 11:1-14.

238. I also note that Loewen expressly discloses that its system has both a laser altimeter and a GPS. *E.g.*, EX1004 (**Loewen**), 3:11-15 ("the tower detecting device is in the form of a laser altimeter… the system also contemplates the use of a GPS capability which cooperates in detecting the presence of a tower structure that is to be photographed"), Figs.8 (showing altimeter 74 and GPS 91), 9-10 (showing both "laser altimeter" and "GPS").

239. Additionally, I note that, as discussed above (*see* cl.1.e), POSITA would have understood that, for each image-capturing event, Loewen's computer system (including its software that executes the functions of Loewen's system) associates each image-data signal from Loewen's image-capturing devices (*e.g.*, still cameras) with the geo-locating signal generated by Loewen's laser altimeter. *See* ¶176.

* * *

240. Thus, in my opinion, Loewen discloses this limitation.

241. Accordingly, in my opinion, claim 3 is rendered obvious over Loewen in view of Fujimoto, Garrot, and Mostafa.

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E. Claim 2 Is Rendered Obvious Over Loewen in View of Fujimoto Garrot, and Mostafa (Ground 2)

242. **In my opinion, claim 2 is rendered obvious over Loewen in view of Fujimoto, Mostafa, and Garrot (Ground 2).** *See infra*, Appendix C, Claim 2.

243. I address here claim 2, based on the same disclosures as I rely on for claim 3. Claim 3, addressed above, is narrower than claim 2 and requires each and every of the recited "geo-locating device[s] and said at least one geo-locating signal[s]," whereas claim 2 requires only "at least one of" the recited geo-locating devices and geo-locating signals recited in claim 3. Thus, for the reasons discussed above with respect to claim 3, claim 2 is rendered obvious over Loewen in view of Fujimoto, Mostafa, and Garrot.

1. Element 2.pre (the preamble of claim 2)[20]

244. Claim 2.pre recites "**The system of claim 1, wherein said at least one geo-locating device and said at least one geo-locating signal respectively comprise at least one of.**" **In my opinion, Loewen in view of Fujimoto renders obvious this limitation.**

245. In my opinion, **Loewen in view of Fujimoto renders obvious the system of claim 1 and includes at least one geo-locating device and said at least**

[20] To the extent deemed limiting, the preamble is disclosed.

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one geo-locating signal respectively comprise (*see* cl.1). The particular geo-locating device and geo-locating signals of the remainder of claim 2 are discussed above, with respect to claim 3, because claim 3, requires each and every of the same "at least one-geolocating device[s] and said at least one geo-locating signal[s], as does claim 2.

2. Element 2.a

246. Claim 2.a recites "**a clock issuing to said image-capturing computer system time data signals indicative of a time of each said image-capturing event.**" **In my opinion, Loewen discloses or renders obvious this limitation.**

247. In my opinion, **Loewen discloses a clock issuing to said image-capturing computer system time data signals indicative of a time of each said image-capturing event** (*see* cl.3.a)**.** *See* discussion of cl.3.a.

* * *

248. Thus, in my opinion Loewen discloses or at minimum renders obvious this limitation.

3. Element 2.b

249. Claim 2.b recites "**a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second**

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image-capturing devices at each said image-capturing event." **In my opinion, Loewen discloses this limitation.**

250. In my opinion, **Loewen discloses a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second image-capturing devices at each said image capturing event** (*see* cl.3.a)**.** *See* discussion of cl.3.b.

* * *

251. Thus, in my opinion, Loewen discloses this limitation.

4. Element 2.c

252. Claim 2.c recites "**an inertial navigation unit (INU) issuing to said image-capturing computer system velocity data signals indicative of a velocity of said first or second image-capturing device at each said image-capturing event.**" **In my opinion, Loewen in view of Mostafa renders obvious this limitation.**

253. In my opinion, **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c)**.** *See* discussion of cl.3.c.

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254. In my opinion, **Mostafa discloses an inertial navigation unit (INU) issuing velocity data signals indicative of a velocity of image-capturing devices at image-capturing events** (*see* cl.3.c)**.** *See* discussion of cl.3.c.

* * *

255. Thus, in my opinion, Loewen in view of Mostafa renders obvious this limitation.

5. Element 2.d

256. Claim 2.d recites "**a gyroscope issuing to said image-capturing computer system a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of said first or second image-capturing device at each said image-capturing event.**" **In my opinion, Loewen in view of Garrot renders obvious this limitation.**

257. In my opinion, **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c, cl.3.d)**.** *See* discussion of cl.3.d.

258. In my opinion, **Garrot discloses a gyroscope issuing a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of image-capturing devices at image-capturing events;** (*see* cl.3.d) to a computer**.** *See* discussion of cl.3.d.

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* * *

259. Thus, in my opinion, Loewen in view of Garrot renders obvious this limitation.

6. Element 2.e

260. Claim 2.e recites "**a compass issuing to said image-capturing computer system heading data signals indicative of a heading of said first or second image-capturing device at each said image-capturing event.**" **In my opinion, Loewen in view of Garrot renders obvious this limitation.**

261. In my opinion, **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c, cl.3.e)**.** *See* discussion of cl.3.e.

262. In my opinion, **Garrot discloses a compass issuing heading data signals indicative of a heading of an image-capturing device at image-capturing events** (*see* cl.3.e) to a computer. *See* discussion of cl.3.e.

* * *

263. Thus, in my opinion, Loewen in view of Garrot renders obvious this limitation

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7. Element 2.f

264. Claim 2.f recites "**an altimeter issuing to said image-capturing computer system altitude data signals indicative of an altitude of said first or second image-capturing device at each said image-capturing event.**" **In my opinion, Loewen discloses this limitation.**

265. In my opinion, **Loewen discloses an altimeter issuing to said image-capturing computer system altitude data signals indicative of an altitude of said first or second image-capturing device at each said image-capturing event** (*see* cl.1.e, cl.3.f)**.** *See* discussion of cl.3.f.

* * *

266. Thus, in my opinion, Loewen discloses this limitation.

267. Accordingly, in my opinion, claim 2 is rendered obvious over Loewen in view of Fujimoto, Garrot, and Mostafa.

F. Claim 4 Is Rendered Obvious Over Loewen in View of Fujimoto and Kain 1997 (Ground 3)

268. **In my opinion, claim 4 is rendered obvious over Loewen in view of Fujimoto and Kain 1997 (Ground 3).** *See infra*, Appendix C, Claim 4.

269. Claim 4 recites "**The system for capturing images and geo-location data corresponding thereto of claim 1, wherein the first or second image-capturing device captures community level oblique aerial images.**" **In my**

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opinion, Loewen in view of Fujimoto and Kain 1997 renders obvious this limitation.

270. As an initial matter, I note that the '657 patent states that "[f]or oblique community-level images, the ground sample distance varies from, for example, approximately one-foot per pixel in the foreground of the image to approximately two-feet per pixel in the mid-ground of the image, and to approximately four-feet per pixel in the background of the image." EX1001 (**'657**), 13:46-60.

271. In my opinion, **Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 1** (*see* cl.1), **wherein the first or second image-capturing devices captures oblique aerial images**[21] (*see* cl.1.a)**.**

272. In my opinion, **Kain 1997 discloses capturing community-level aerial images** (*e.g.*, "one foot per pixel image resolution"; "one foot image resolution")**.**

273. For example, Kain 1997 discloses images having "one foot per pixel image resolution," which are **community level aerial images**: "The disk storage unit 32 must have sufficient storage volume and a sufficient data transfer rate to store image data supplied by the frame grabber 28. Consider an airborne mission requiring

[21] *See* ¶130.

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one foot per pixel image resolution and an aircraft speed of l 00 knots at one frame per second. The 640 x 480 pixel single camera image frame provides a 65% overlap between images (480 pixel dimension along direction of motion). At one byte per pixel for each of the three cameras, a data storage rate of 0.92 megabyte per image, or 0.92 megabyte per second, is required. A conservative 1.5 megabyte per second storage rate is used as the nominal image storage transfer rate specification." *E.g.*, EX1008 (**Kain 1997**), 10:11-18; *see also, e.g.*, EX1008 (**Kain 1997**), 12:13-22 ("In one operating mode, the end user makes arrangements to lease an aircraft and performs mission planning. Using the ground processing workstation 12, the user lays out the survey area to be imaged by selecting boundary points on a digital map. As indicated above, the ground processing workstation considers the endurance and turning properties of the aircraft to be used, the base airport location and camera parameters. This allows the automatic design of a three-dimensional trajectory for the aircraft, with image collection points selected for ideal coverage of the survey area. The trajectory, or multiple mission trajectories, is presented to the user for approval. Higher resolution requirements require more passes and possibly additional missions. A three-hour mission with two hours of the flight time collecting image data provides over 20,000 acres (32 square miles) of image coverage at a **one foot image resolution**.").

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274. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed first image-capturing device that captures oblique aerial images using Kain's advantageous disclosure of capturing images including one foot per pixel image resolution** (which POSITA would have understood is a community-level aerial image consistent with the '657 patent's explanation of that term), such that the first image-capture device in the resulting system captures community-level oblique aerial images in appropriate contexts, including for larger structures where small detail is of lesser concern, such as photographing the right-of-way (*i.e.*, the path defined by the tower structures and the transmission cables between towers) "to inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees and other plant growth or the like have encroached into the right-of-way and is presenting a potential interference with the transmission line," and to "provide aerial images of ground structures… roadways and the like." *E.g.*, EX1004 (**Loewen**), 2:23-26, 5:37-41; *see also id.* at 2:19-21 ("Another objective of this invention is to provide a reliable and accurate record of the right-of-way of an electric transmission line, and to do so in **a cost-effective manner**."). Capturing community-level oblique aerial images of one-foot per pixel in the foreground of the image (in contexts, as noted above, where higher-resolution images are not required, such as capturing the right-of-way or roadways or identifying downed transmission

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towers following a severe storm), two-feet per pixel in the mid-ground, and four-feet per pixel in the background would have advantageously reduced storage requirements as compared to images captured at a higher-resolution, thereby allowing for a greater number of images to be captured and stored while still providing sufficient detail for various uses of such imagery, including, *e.g.*, to identify downed transmission towers following a severe storm (which would require less detailed imagery). Allowing for a greater number of images to be captured would have, *e.g.*, advantageously allowed for more views of the structures or areas of interest and/or more structures or areas of interest to be captured by the combined system in a single flight, thus beneficially increasing the coverage of the capture system. For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images of different resolution was well-known and conventional by varying well-known camera parameters (*e.g.*, field of view, sensor size) and distance from which an image is taken, and clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

275. It is also my opinion that POSITA would have understood Loewen to disclose a 45 degree camera angle and a field of view at the upper end of the conventional and well-known range (as shown for cl.1.a), and that using this disclosure and Kain 1997's expressly-disclosed "one foot per pixel image

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resolution," oblique aerial images captured by Loewen's image-capturing devices would have had a ground sample distance of one foot per pixel in the foreground of the image, and decreasing resolutions (*e.g.*, more feet per pixel) in the mid-ground and background of such images, due to well-understood geometric principles. *See* ¶¶123-130.

* * *

276. Thus, in my opinion, Loewen in view of Kain 1997 renders obvious the additional limitation of claim 4.

277. Accordingly, in my opinion, claim 4 is rendered obvious over Loewen in view of Fujimoto and Kain 1997.

G. Claim 5 Is Rendered Obvious Over Loewen in View of Fujimoto or Alternatively, Over Loewen in View of Fujimoto and Mostafa (Grounds 1 and 4)

278. **In my opinion, claim 5 is rendered obvious over Loewen in view of Fujimoto (Ground 1), or alternatively, Loewen in view of Fujimoto and Mostafa (Ground 4).** *See infra*, Appendix C, Claim 5.

279. Claim 5 recites "**The system for capturing images and geo-location data corresponding thereto of claim 1, wherein the second image-capturing device captures orthogonal images at image-capturing events.**" **In my opinion, Loewen in view of Fujimoto (Ground 1), or alternatively, Loewen in view of Mostafa (Ground 4) render obvious this limitation.**

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280. In my opinion, **Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 1** (*see* cl.1).

281. **Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 1** (*see* cl.1), **and Loewen discloses the second image-capturing device captures images at image-capturing events** (*see* cl.1.b)**. Loewen renders obvious the second image-capturing device capturing *orthogonal* images at image-capturing events.**

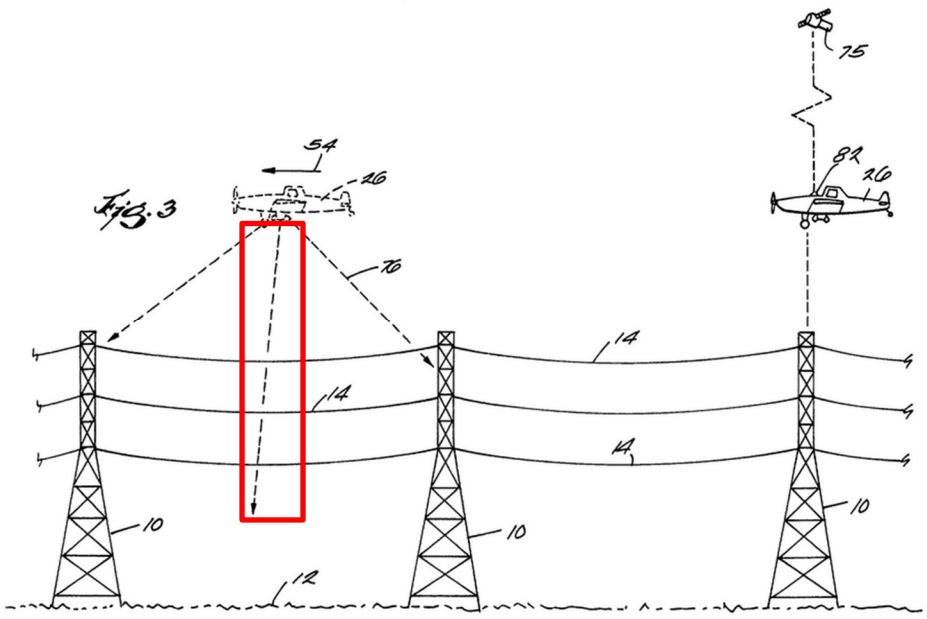
282. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement one of Loewen's disclosed multiple still cameras using Loewen's advantageous teachings of downward-facing video cameras such that in the resulting system Loewen's second image-capturing device captures orthogonal images at image-capturing events.** Indeed, Loewen expressly discloses that the "number and arrangement of cameras can vary," *e.g.*, EX1004 (**Loewen**), 5:62-6:2, and expressly discloses video cameras that point downward. *E.g.*, EX1004 (**Loewen**), 8:8-14 ("[T]he video camera 40 is arranged at 90 degrees, perpendicular to the horizontal, and takes pictures along a line 78 that is perpendicular to the line of flight."); 3:23-36 ("[O]ne video camera is arranged to take pictures along an exposure line which is at an angle

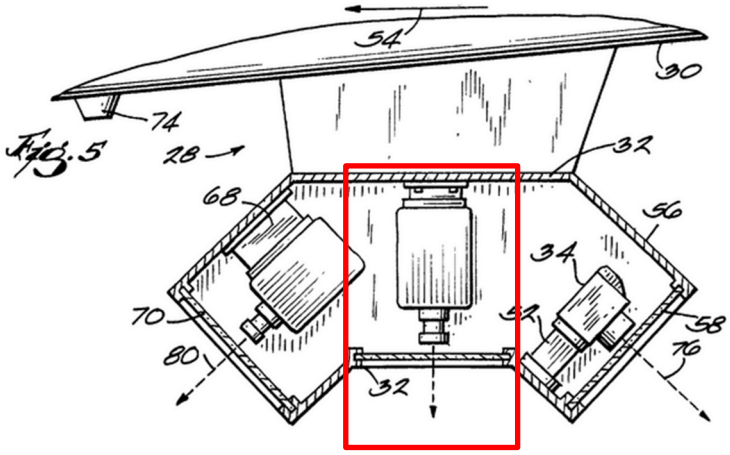
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of substantially 90 degrees to the horizontal and directed downwardly relative to the aircraft line of flight…."); 6:3-30 ("[A] second camera 40 looks down."); Figs.3, 5-6. Loewen further expressly discloses that its disclosed downward-pointing video cameras—which are used, *e.g.*, "for filming the right-of-way" to "inspect [its] integrity… [and] determine… if things such as trees and other plant growth or the like have encroached… and… present[] a potential interference"—advantageously produce still images. *E.g.*, EX1004 (**Loewen**), 8:54-57, 5:38-42, 6:3-7 ("The… video cameras used… operate in a progressive scan mode which produces… relatively clear still images that can be used in post process viewing."). Using a downward-facing still camera to take periodic (orthogonal) still photographs, rather than a downward-facing video camera (which is replaced by the second image-capturing device (still camera) in this combination), would have reduced the memory used by the system by replacing memory-intensive video recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Using one of Loewen's still cameras rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004 (**Loewen**), 2:19-21. This would have advantageously

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enabled the combined system to provide more detail of captured structures, the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.





283. I note that although the center dashed line and arrow in Figure 3 of Loewen appear to be at an angle, Loewen expressly discloses that its downward-facing camera is "arranged at 90 degrees, perpendicular to the horizon," and is thus orthogonal. EX1004 (**Loewen**), 8:8-14.

284. **Loewen in view of Mostafa also renders this limitation obvious (Ground 4) based on the same Loewen disclosures immediately above in addition to the Mostafa disclosures below, including in particular a "digital camera[]… which is nadir."**

285. In my opinion, **Mostafa discloses an image-capturing device capturing orthogonal images at image-capturing events** (*e.g.*, "digital camera[]… which is nadir" and captures "nadir digital image[s]")**.**

286. As an initial matter, I note that POSITA would have understood that "nadir" means pointing directly down, and thus would have understood that Mostafa discloses capturing "orthogonal" images. EX1018.

287. For example, Mostafa discloses an image-capturing device that captures nadir (*i.e.*, orthogonal) images at image-capturing events: "In this paper, the development and testing of an airborne fully digital multi-sensor system for digital mapping data acquisition is presented. **The system acquires two streams of data, namely**, navigation (georeferencing) data and **imaging data.** The navigation data are obtained by integrating an accurate strapdown inertial navigation system with a differential GPS system (DGPS). The imaging data are acquired by two low-cost digital cameras, configured in such a way so as to reduce their geometric limitations. **The two cameras capture strips of overlapping nadir and oblique images.** The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft. Thus, image exterior orientation information is extracted from the trajectory, during post-processing. This approach eliminates the need for ground control (GCP) when computing 3D positions of objects that appear in the field of view of the system imaging component. Two approaches for calibrating the system are presented, namely, terrestrial calibration and in-flight calibration. Test flights were conducted over the campus of The University of Calgary. Testing the system showed that best ground point positioning accuracy at 1:12,000 average image scale is 0.2 m (RMS) in easting and northing and 0.3 m (RMS) in height. Preliminary results indicate that major applications of such a system in the future are in the field of digital mapping, at scales of 1:5000 and

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smaller, and in the generation of digital elevation models for engineering applications." *E.g.*, EX1007 (**Mostafa**), Abstract; *see also, e.g.*, EX1007 (**Mostafa**), 4 ("Therefore, the imaging component of the system has been designed to include ***two low-cost 1.5 X 1 K digital cameras, one of which is nadir***, and the other is oblique. This allows for ***covering the same ground scene with a nadir and an oblique image*** that, when simultaneously processed, provides a wider intersection angle and thus better height accuracy."), 6 ("Fig. 4 shows the radial lens distortion profiles estimated during the pre- (solid lines) and post-flight (dashed lines) calibration for the ***nadir camera*** and the oblique camera. The digital camera calibration results agree with a previous work reported… especially for the ***nadir camera*** typically equipped with a 28-mm lens."), 9 ("The GPS/INS interpolated position and attitude angles at each exposure station were used together with the imagery to analyse the system performance when using ***nadir plus oblique images***. After preprocessing the GPS/INS data to compensate for the position and orientation offsets between the navigation and imaging sensors, the compensated position and attitude parameters were used as observable exterior orientation parameters (in M-frame) together with their standard deviations and the image point measurements from the commercial software package PCI OrthoEngine.").

288. Indeed, Mostafa discusses using a "stereopair of nadir images" captured by its image-capturing system: "The analysis was done as follows: using a stereopair

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of ***nadir images***; using a stereopair of ***nadir images*** plus an extra oblique image; using a ***strip of five nadir images***; using a strip of ***five nadir images*** plus extra oblique images as available; using a block of 3 X 3 ***nadir images***; and using a block of 3 X ***3 nadir images*** and oblique images in addition to cross strips in both directions." *E.g.*, EX1007 (**Mostafa**), 10, Fig.6:

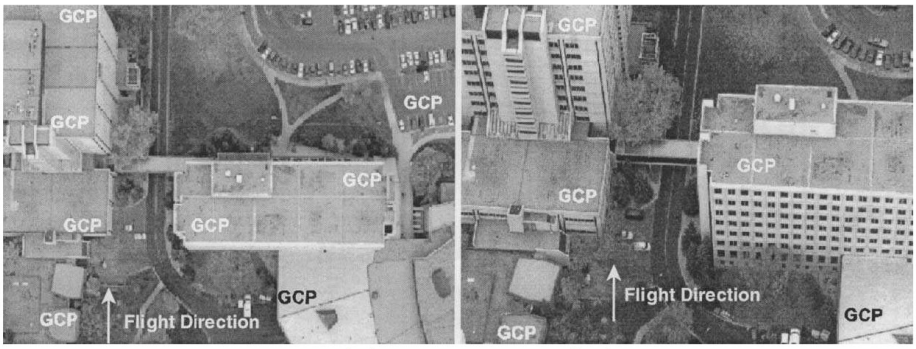


Fig. 6. A nadir digital image (left) and an oblique digital image (right), October 1998 flights.

289. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement one of the multiple still cameras of the combined Loewen-Fujimoto aerial image-capturing system, which captures oblique aerial images using "still, digital cameras," and captures orthogonal images using, *e.g.*, a video camera "arranged at 90 degrees" for, *e.g.*, "filming the right-of-way" (*e.g.*, EX1004 (Loewen), 2:30-36, 5:38-42, 5:62-6:2 ("number and arrangement of cameras can vary"), 8:8-14, 8:54-57) using Mostafa's advantageous disclosure of a downward-facing (*e.g.*, "nadir," EX1007 (Mostafa), Abstract) still camera instead of Loewen's downward-facing video camera.** As POSITA would have understood and

immediately recognized, using a downward-facing still camera, as expressly disclosed by Mostafa (*e.g.*, EX1007 (**Mostafa**), Abstract), to take periodic orthogonal still photographs, rather than a downward-facing video camera (which is replaced by the second image-capturing device (still camera) in this combination), would have reduced the memory used by the system by replacing memory-intensive *video* recordings with a series of discrete *still* photographs separated in time, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video), beneficially increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Moreover, Mostafa expressly discloses that the use of a nadir digital still camera "allows for covering the same ground scene with a nadir and an oblique image that, when simultaneously processed, provides a wider intersection angle and thus better height accuracy." *E.g.*, EX1007 (**Mostafa**), 4. Using one of Loewen's still cameras rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004 (**Loewen**), 2:19-21. This would have advantageously enabled the combined system to provide higher accuracy (including as to the height of any transmission towers to ascertain whether such towers are leaning or their foundations have settled), more detailed images of captured structures, the right-of-way, or other capture objectives at a lower cost,

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increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

290. Thus, in my opinion, Loewen in view of Fujimoto renders obvious this limitation, or alternatively, Loewen in view of Mostafa renders obvious the additional limitation of claim 5.

291. Accordingly, in my opinion, claim 5 is rendered obvious over Loewen in view of Fujimoto, or alternatively, Loewen in view of Fujimoto and Mostafa.

H. Claim 14 Is Rendered Obvious Over Loewen in View of Fujimoto (Ground 1)

292. **In my opinion, Claim 14 is rendered obvious over Loewen in view of Fujimoto.** *See infra*, Appendix C, Claim 14.[22]

[22] As discussed below, this mapping for Ground 1 is applicable to the claims that further depend from claim 14 (claims 19-21 and 26-27) and that are addressed in Grounds 1 and 3-7.

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293. Claim 14 recites "**The system for capturing images and geo-location data corresponding thereto of claim 1, further comprising a platform carrying the first and second image-capturing devices through a controlled flight.**"

294. **Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 1** (*see* cl.1)**, and Loewen further discloses a platform carrying the first and second image capturing devices** (*see* cl.1.a., cl.1.b) **through a controlled flight** (*e.g.*, "fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images"; "fixed wing aircraft and an arrangement of at least one still camera"; "fixed wing aircraft… pod… fixed to the underside… of the aircraft fuselage" that "includes a number of cameras"; *see* cl.1.a, cl.1.b)**.**

295. As an initial matter, I note that '657 explains that "platform" includes an "airplane." EX1001 (**'657**), 4:4-16 ("Platform 20, such as, for example, an airplane… carries image-capturing system 30 over a predefined area of and at one or more predetermined altitudes above surface 31, such as, for example, the earth's surface or any other surface of interest."). To the extent it is argued that the "platform" requires a "pod" or other structure affixed to an aircraft, Loewen expressly discloses this. *E.g.*, EX1004 (**Loewen**), 5:43-66, Figs.2, 5-6.

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296. Loewen discloses **a platform** (*e.g.*, fixed wing aircraft) **carrying a first and second image-capturing devices** (*e.g.*, Loewen's still cameras) **through a controlled flight**. For example, Loewen discloses: "A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. **The system uses a fixed wing aircraft and an arrangement of at least one still camera**, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. **The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet).** The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees. The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined

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exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way." *E.g.*, EX1004 (**Loewen**), Abstract; *see also, e.g.*, EX1004 (**Loewen**), 2:30-38 ("**For the achievement of these and other objects, this invention proposes a system utilizing a fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images of the electric transmission line tower structures and equipment attached to those towers.** Although this discussion will refer to the use of plural cameras, it will be appreciated that this invention contemplates the use of one or more still cameras."), 2:39-49 ("In accordance with this invention, the still cameras take pictures of the towers from an exposure point between two adjacent towers and along an exposure line that is at a shallow angle to the horizontal. **The horizontal is defined in terms of the desired line of flight of the aircraft; the line of flight being generally parallel to the terrain over which the transmission lines**

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are strung and over which the aircraft is flying. The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees."), 2:50-3:2 ("More specifically, **the aircraft is flown along the transmission line at a low altitude, preferably 60–100 feet above the tops of the tower structures. The aircraft speed is in the range of 80–100 miles per hour.** That altitude and speed allow the use of advantageous exposure parameters (shutter speed, lens opening and resulting depth of field) for the cameras such as to result in capturing the high quality, still, high resolution images."), 4:35-40 ("**The system can also incorporate displays in the aircraft cockpit to allow the pilot to monitor the line of flight of the aircraft relative to the right-of-way and/or to monitor the state of operation of the image capture portion of the system.** In addition, a flash assembly can be used to enhance the photos being taken."), 5:55-61 ("**The use of the Piper Pawnee is desirable, as it is capable of consistent and reliable flight at the low altitude and low speeds of the system of this invention.** For example, the aircraft can fly continuously over the tower structures at a ground speed and altitude preferred in this invention, namely approximately 80–100 miles per hour and an altitude of 80–100 feet above the tops of the tower structures.").

297. Loewen further illustrates both its aircraft during a controlled flight and shows the attachment of Loewen's image-capturing devices to Loewen's aircraft:

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"FIG. 1 is a generally schematic, perspective view of an aircraft flying over a transmission line in accordance with this invention." *E.g.*, EX1004 (**Loewen**), 4:48-50; *see also, e.g.*, EX1004 (**Loewen**), 4:51-52 ("FIG. 2 is a generally schematic view of an aircraft incorporating the system of this invention."), 4:53-54 ("FIG. 3 is a generally schematic, side view of the aircraft of FIG. 2 flying over the transmission line."), 4:58-60 ("FIG. 5 is partial view of the aircraft fuselage and the pod attached to the fuselage with the interior of pod exposed to show the cameras."), 4:61 ("FIG. 6 is a bottom view of the pod and cameras."), 4:62-64 ("FIG. 7 is a view of the instrument panel and windshield of the aircraft as viewed from the interior of the cockpit of the aircraft."), Figs.1-3, 5-7:

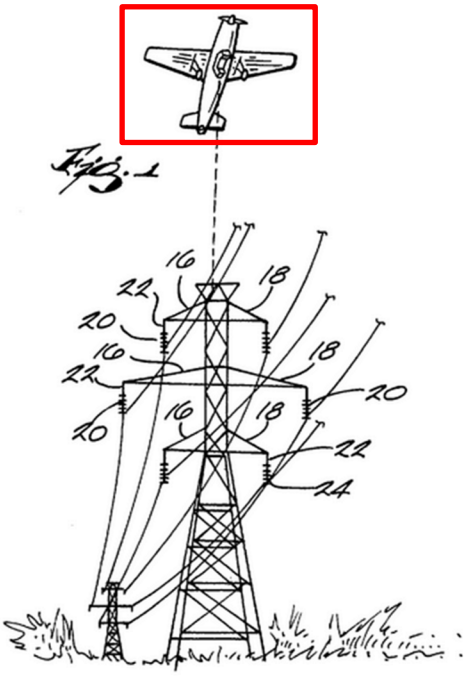


Fig. 2

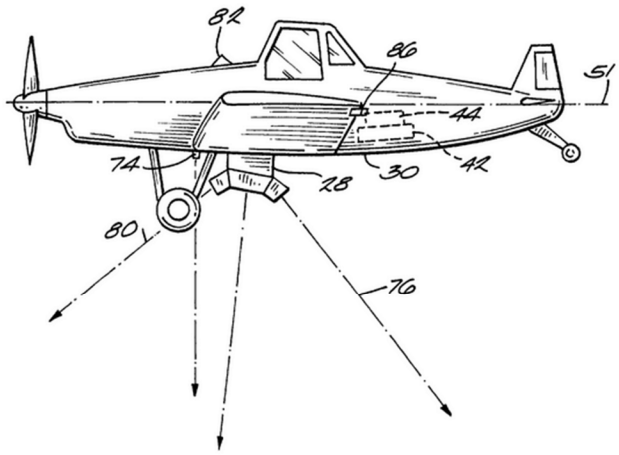


Fig. 3

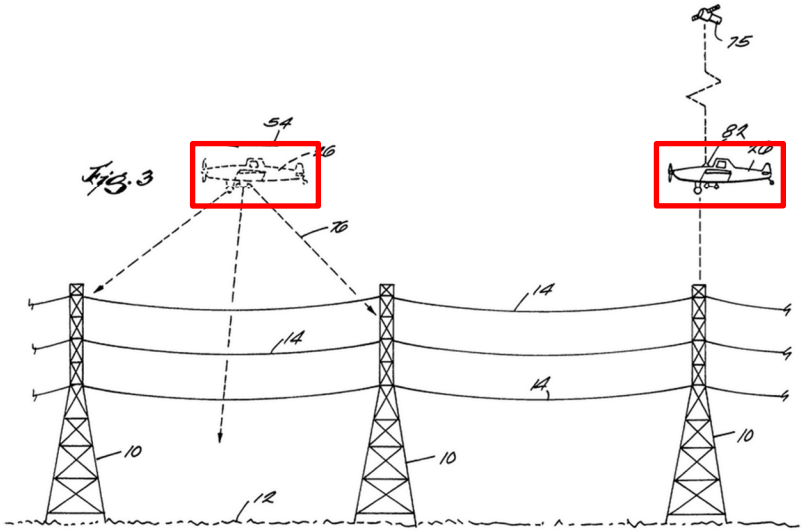
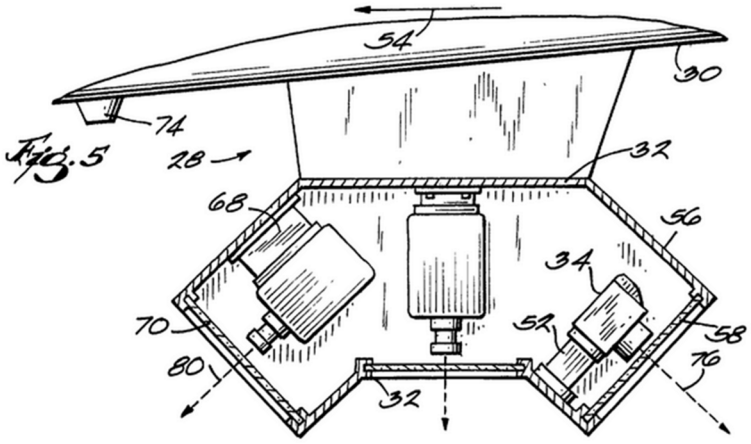


Fig. 5



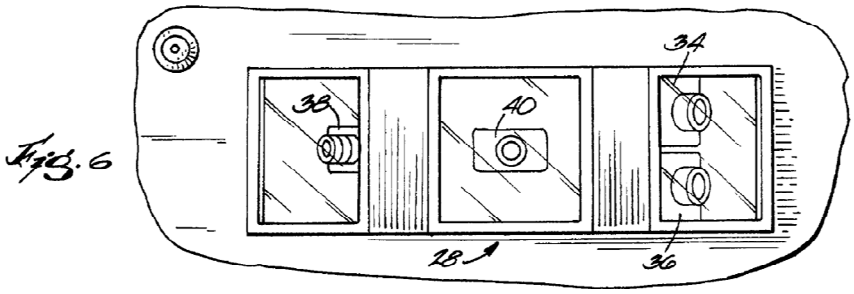


Fig. 6

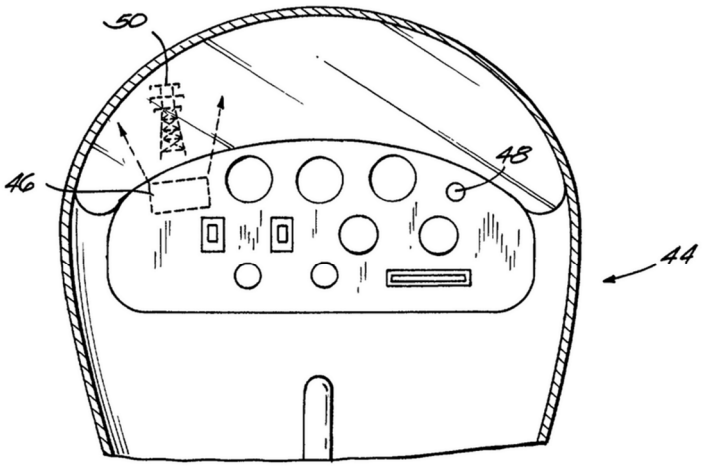


Fig. 7

298. As shown above (*e.g.*, EX1004 (**Loewen**), Figs.5-6), in addition to expressly disclosing an aircraft carrying Loewen's image-capturing devices through a controlled flight, Loewen further discloses **a platform** in the form of a "pod" attached to Loewen's aircraft carrying Loewen's image capturing systems through a controlled flight: "To that end and in accordance with this invention, **a fixed wing aircraft 26 is equipped with a data collection system**. **In the preferred embodiment of this invention, the fixed wing aircraft is a Piper Pawnee of the type commonly used in crop dusting applications.** The data collection system

includes **a pod 28 fixed to the underside 31 of the aircraft fuselage** generally in the area which would coincide with the center of gravity of the aircraft. Locating the pod in the area of the center of gravity minimizes the error in the data collection system that can occur due to movement of the aircraft from the preferred line of flight, as will be described and/or become evident from the description to follow." *E.g.*, EX1004 (**Loewen**), 5:43-54; *see also, e.g.*, 5:61-64 ("The **data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures**."), 6:31-40 ("The **digital still cameras are supported in the pod** by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The **cameras look through a short tunnel section 56 of the pod housing**. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses."), cl.31 ("an aircraft, a data collection pod connected to the underside of said aircraft, said data collection pod including: a housing attached to said fuselage, a digital still camera supported in said housing").

* * *

299. Thus, in my opinion, Loewen in view of Fujimoto renders obvious the additional limitation of claim 14.

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300. Accordingly, in my opinion, claim 14 is rendered obvious over Loewen in view of Fujimoto.

I. Claim 19 Is Rendered Obvious Over Loewen in View of Fujimoto (Ground 1)

301. **In my opinion, Claim 19 is rendered obvious over Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa.** *See infra*, Appendix C, Claim 19.

302. Claim 19 recites "**The system for capturing images and geo-location data corresponding thereto of claim 14, wherein the first and second image-capturing devices have different angles of declination.**"

303. **Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 14** (*see* cl.14)**, and Loewen further discloses first and second image-capturing devices** (*see* cl.1.a, cl.1.b) **each directed at a 30-60 degree angle to the line of flight** (*e.g.*, "still cameras are arranged to take pictures… at an angle to the line of flight… in the range of 30–60 degrees"; "still photographs are taken along a line which is 30–60 degrees to the horizontal"; *see* cl.1.a-1.b, cl.5)**. As discussed below, Loewen renders obvious or Loewen in view of Mostafa renders obvious those image-capturing devices having different angles of declination.**

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304. Loewen discloses that "[t]he still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees." *E.g.*, EX1004 (**Loewen**), Abstract; *see also, e.g.*, EX1004 (**Loewen**), 2:46-49 ("The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees."). Similarly, Loewen discloses orienting its still at various angles to the line of flight, including angles from 30 to 60 degrees, explaining that "[u]sing the line of flight of the aircraft 54 as a base of reference, a reference base which corresponds generally with the longitudinal axis of the aircraft, the still cameras are arranged to take pictures along a line 76 at an angle to the line of flight. That angle is in the range of 30–60 degrees, preferably 45." *E.g.*, EX1004 (**Loewen**), 7:62-67; *see also, e.g.*, EX1004 (**Loewen**), 11:45-47 ("The still photographs are taken along a line which is 30–60 degrees to the horizontal, preferably 45 degrees.").

305. In my opinion, Loewen renders obvious this limitation. As discussed above (*see* cl.1.a, cl.1.b), Loewen discloses that each of its first image-capturing device and second image-capturing device is pointing backwards ("rearwardly") and "directed downwardly at an angle to the line of flight, 30-60 degrees." *E.g.*, EX1004 (**Loewen**), Abstract. **POSITA would have been motivated and found it obvious,**

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straightforward, and advantageous to implement Loewen's disclosure of first and second image-capturing devices directed downwardly at an angle of declination of 30-60 degrees using different angles of declination for the first and second image-capturing devices. POSITA would have recognized that using different angles of declination for the first and second image-capturing devices would advantageously improve the variety of imagery data and detail produced with fewer surveys and provide more accurate measurement of the height of objects appearing in images captured by both cameras, allowing users to extract additional information (from employing a variety of perspectives) while balancing imagery survey costs. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

306. Alternatively, it is my opinion that Loewen renders obvious this limitation, at minimum, because Loewen renders obvious the system described in claim 5, *i.e.*, the system of Loewen having the first image-capturing device directed in an oblique angle and the second image-capturing device directed in an orthogonal angle. POSITA would understand that this arrangement has first and second image-capturing devices having different angles of declination, because the angle of declination of the first image-capturing device is 30-60 degrees and the angle of

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declination of the second-image capturing device is 90 degrees. As explained above (*see* cl.5), **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement one of Loewen's disclosed multiple still cameras using Loewen's advantageous teachings of downward facing cameras such that in the resulting system Loewen's second image-capturing device captures orthogonal images at image-capturing events.** Indeed, Loewen expressly discloses using "one or more" still cameras and that the "number and arrangement of cameras can vary" (*e.g.*, EX1004 (**Loewen**), 2:36-38, 5:62-6:2), and expressly discloses cameras that point downward. *E.g.*, EX1004 (**Loewen**), 8:8-14 ("[T]he video camera 40 is arranged at 90 degrees, perpendicular to the horizontal, and takes pictures along a line 78 that is perpendicular to the line of flight."); 3:23-36 ("[O]ne video camera is arranged to take pictures along an exposure line which is at an angle of substantially 90 degrees to the horizontal and directed downwardly relative to the aircraft line of flight…."); 6:3-30 ("[A] second camera 40 looks down."); Figs.3, 5-6. Loewen further expressly discloses that its disclosed downward-pointing video cameras—which are used, *e.g.*, "for filming the right-of-way" to "inspect [its] integrity… [and] determine… if things such as trees and other plant growth or the like have encroached… and… present[] a potential interference"—advantageously produce still images. *E.g.*, EX1004 (**Loewen**), 8:54-57, 5:38-42, 6:3-7 ("The… video cameras used… operate in a progressive scan mode

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which produces… relatively clear still images that can be used in post process viewing."). Using a downward-facing still camera to take periodic orthogonal still photographs, rather than a downward-facing video camera (which is replaced by the second image-capturing device (still camera) in this combination), would have reduced the memory used by the system by replacing memory-intensive video recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video at similar resolutions, thus permitting the still camera to capture even higher resolution imagery), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Using one of Loewen's still cameras rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004 (**Loewen**), 2:19-21. This would have advantageously enabled the combined system to provide more detail of captured structures, the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

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307. Alternatively, for the same reasons as discussed immediately above and with respect to claim 5 (¶¶284-289), it is my opinion that Loewen in view of Mostafa renders obvious this limitation, at minimum, because Loewen-Fujimoto-Mostafa renders obvious the system described in claim 5, *i.e.*, the multiple still cameras of the Loewen-Fujimoto system using Mostafa's advantageous teachings of a downward facing (*e.g.*, "nadir," EX1007 (**Mostafa**), Abstract) still camera instead of Loewen's downward-facing video camera. *See* cl.5. As discussed immediately above and with respect to cl.5, for POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

308. Thus, in my opinion, Loewen in view of Fujimoto renders obvious the additional limitation of claim 19.

309. Accordingly, in my opinion, claim 19 is rendered obvious over Loewen in view of Fujimoto.

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J. Claim 20 Is Rendered Obvious Over Loewen in View of Fujimoto, or Alternatively, Loewen in View of Fujimoto and Mostafa (Grounds 1 and 4)

310. **In my opinion, Claim 20 is rendered obvious over Loewen in view of Fujimoto, or alternatively, Loewen in view of Fujimoto and Mostafa (Ground 4).** *See infra*, Appendix C, Claim 20.[23]

311. Claim 20 recites "**The system for capturing images and geo-location data corresponding thereto of claim 14, further comprising a third image-capturing device, wherein the first and second image-capturing devices are capturing oblique aerial images and the third image-capturing device is capturing orthogonal aerial images.**"

312. In my opinion, **Loewen discloses the system for capturing images and geo-location data corresponding thereto of claim 14** (*e.g.*, cl.14)**, further comprising a third image-capturing device**[24] (*e.g.*, "still camera"; "one or more still cameras"; "number and arrangement of the cameras can vary")**, wherein the first** (*e.g.*, cl.1.a) **and second image-capturing devices** (*e.g.*, second "still camera";

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[23] As discussed below, this mapping for Ground 20 is applicable to the claims that further depend from it and that are addressed in Grounds 1 (claim 21), 3 (claim 26), 4 (claim 21), 5 (claim 26), and 6-7 (claim 27).

[24] *See* n.9.

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"still camera 36" Fig.6); *see* cl.1.b) **are capturing oblique aerial images**[25] (*e.g.*, "The still camera points rearwardly relative to the line of flight of the aircraft and take a picture… at an angle to the line of flight, 30–60 degrees and preferably 45 degrees")**.**

313. As an initial matter, and as discussed above (*see* n.9), I note that POSITA would have understood Loewen's reference to "**one or more still cameras**" (EX1004 (**Loewen**), 2:36-38)—instead of "one or two still cameras"—to be an explicit disclosure of at least three still cameras. EX1004 (**Loewen**), 2:36-38. Loewen further makes clear that the "number and arrangement" of its image-capturing devices can vary, and that its system is not limited to including just two still cameras, explaining that "[t]he data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures, the equipment supported on the tower structures and the transmission cables themselves, as well as images of the right-of-way. **The number and arrangement of the cameras can vary**, but preferably two digital still cameras 34 and 36 and two digital video cameras 38 and 40 are mounted within the housing." *E.g.*, EX1004 (**Loewen**), 5:62-6:2. *See* n.9

[25] *See* ¶130.

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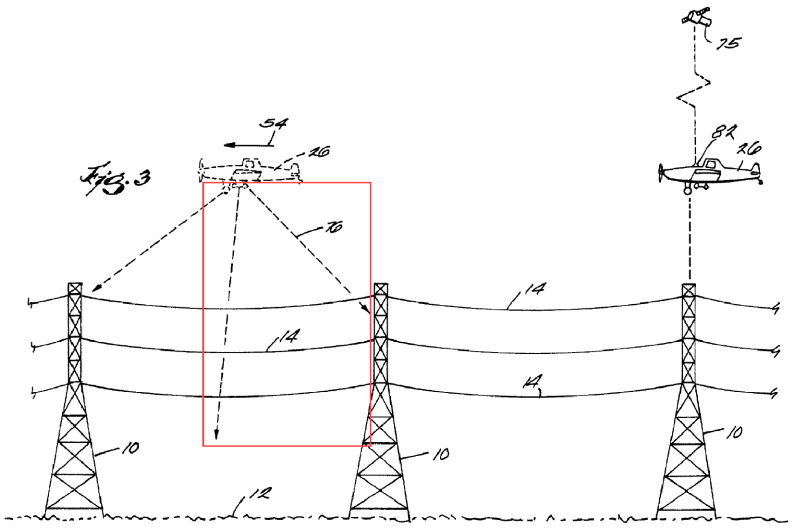
314. Loewen discloses that its image-capturing devices (*e.g.*, rearward-facing still cameras) capture oblique aerial images (as discussed above, *see* ¶121): "A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). **The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees.** The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be

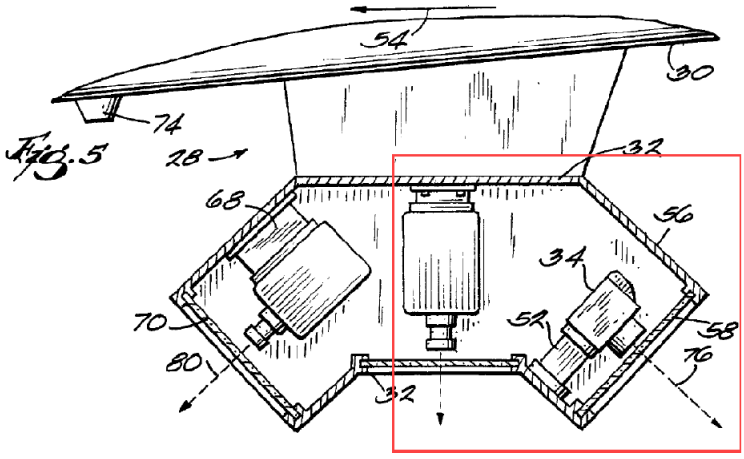
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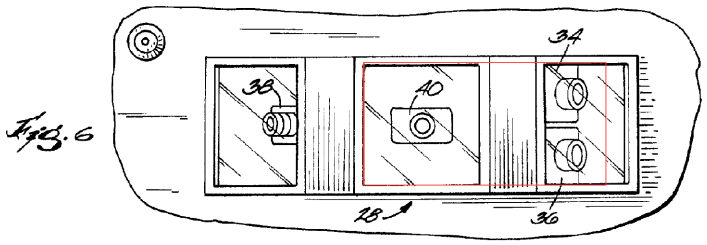
photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way." *E.g.*, EX1004 (**Loewen**), Abstract, 2:39-49 ("In accordance with this invention, the still cameras take pictures of the towers from an exposure point between two adjacent towers and along an exposure line that is at a shallow angle to the horizontal. The horizontal is defined in terms of the desired line of flight of the aircraft; the line of flight being generally parallel to the terrain over which the transmission lines are strung and over which the aircraft is flying. **The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees.**"), 7:62-8:7 ("Using the line of flight of the aircraft 54 as a base of reference, a reference base which corresponds generally with the longitudinal axis of the aircraft, **the still cameras are arranged to take pictures along a line 76 at an angle to the line of flight. That angle is in the range of 30–60 degrees, preferably 45 degrees.** Since the aircraft will make its fly over in a

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horizontal flight altitude, this direction or line of flight will be referred to as horizontal and the angle of the camera orientation will be referred to as being at an angle to the horizontal. It being noted, in that altitude the axis 51 of the aircraft is normally horizontal and the camera exposure angles could also be described in reference to the longitudinal axis of the aircraft."), Figs.3, 5-6:







315. In my opinion, **Loewen renders obvious the third image-capturing device capturing orthogonal aerial images** (*see* cl.5)**. Thus, Loewen renders obvious this limitation.**

316. I note that as discussed with respect to cl.5, Loewen discloses a third still camera and a video camera that captures orthogonal aerial images, and Loewen renders obvious a "still camera" (*i.e.*, image-capturing device") capturing orthogonal images at image-capturing events. *E.g.*, EX1004 (**Loewen**), 5:62-6, 8:8-14, 3:23-36. I rely on those same disclosures for the "capturing orthogonal aerial images" limitation of cl.20, and the disclosures discussed immediately above (¶313) for the "third image-capturing device."

317. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed two rear-facing still cameras (which capture oblique aerial images at image-capturing events) (which Loewen expressly discloses would have advantageously allowed one camera to be oriented to capture landscape-type images and the other camera to capture portrait photographs (*see* EX1004**

(Loewen), 11:36-40)) using Loewen's advantageous teachings of an additional downward-facing camera (in place of the video camera) such that in the resulting system Loewen's first and second image-capturing devices capture oblique aerial images at image-capturing events and a third image-capturing device (e.g., still camera) captures orthogonal images at image-capturing events. Indeed, Loewen expressly discloses that the "number and arrangement of cameras can vary" (*e.g.*, EX1004 (**Loewen**), 5:62-6:2), and expressly discloses cameras that point downward. *E.g.*, EX1004 (**Loewen**), 8:8-14 ("[T]he video camera 40 is arranged at 90 degrees, perpendicular to the horizontal, and takes pictures along a line 78 that is perpendicular to the line of flight."); 3:23-36 ("[O]ne video camera is arranged to take pictures along an exposure line which is at an angle of substantially 90 degrees to the horizontal and directed downwardly relative to the aircraft line of flight…."); 6:3-30 ("[A] second camera 40 looks down."); Figs.3, 5-6. Loewen further expressly discloses that its disclosed downward-pointing video cameras—which are used, e.g., "for filming the right-of-way" to "inspect [its] integrity… [and] determine… if things such as trees and other plant growth or the like have encroached… and… present[] a potential interference"—advantageously produce still images. *E.g.*, EX1004 (**Loewen**), 8:54-57, 5:38-42, 6:3-7 ("The… video cameras used… operate in a progressive scan mode which produces… relatively clear still images that can be used in post process viewing."). Using a

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downward-facing still camera to take periodic orthogonal still photographs (triggered by, *e.g.*, Loewen's laser altimeter detecting an object in the right-of-way and sending a signal to Loewen's onboard computer, which in turn triggers Loewen's image-capturing devices (*see* ¶¶182-184), or configured to capture still images at set intervals rather than continuous, memory-intensive video recordings), rather than a downward-facing video camera, would have reduced the memory used by the system by replacing memory-intensive video recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video at similar resolutions, thus permitting the still camera to capture even higher resolution imagery), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Using a still camera rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004 (**Loewen**), 2:19-21. This would have advantageously enabled the combined system to provide more detail of captured structures, the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would

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work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

318. **In my opinion, Loewen in view of Mostafa also renders this limitation obvious based on the same Loewen disclosures above in addition to the Mostafa disclosures below, including in particular a "digital camera[]… which is nadir" (Ground 4)**.

319. In my opinion, **Mostafa discloses an image-capturing device capturing orthogonal images** (*e.g.*, "digital camera[]… which is nadir" and captures "nadir digital image[s]")**.**

320. For example, Mostafa discloses a camera capturing "nadir" (*i.e.*, orthogonal) aerial images: "In this paper, the development and testing of an airborne fully digital multi-sensor system for digital mapping data acquisition is presented. **The system acquires two streams of data, namely**, navigation (georeferencing) data and **imaging data.** The navigation data are obtained by integrating an accurate strapdown inertial navigation system with a differential GPS system (DGPS). The imaging data are acquired by two low-cost digital cameras, configured in such a way so as to reduce their geometric limitations. **The two cameras capture strips of overlapping nadir** and oblique **images.** The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft. Thus, image exterior orientation information is extracted from the trajectory, during post-

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processing. This approach eliminates the need for ground control (GCP) when computing 3D positions of objects that appear in the field of view of the system imaging component. Two approaches for calibrating the system are presented, namely, terrestrial calibration and in-flight calibration. Test flights were conducted over the campus of The University of Calgary. Testing the system showed that best ground point positioning accuracy at 1:12,000 average image scale is 0.2 m (RMS) in easting and northing and 0.3 m (RMS) in height. Preliminary results indicate that major applications of such a system in the future are in the field of digital mapping, at scales of 1:5000 and smaller, and in the generation of digital elevation models for engineering applications." *E.g.*, EX1007 (**Mostafa**), Abstract; *see also, e.g.*, EX1007 (**Mostafa**), 4 ("Therefore, the imaging component of the system has been designed to include ***two low-cost 1.5 X 1 K digital cameras, one of which is nadir***, and the other is oblique. This allows for ***covering the same ground scene with a nadir*** and an oblique ***image*** that, when simultaneously processed, provides a wider intersection angle and thus better height accuracy."), 6 ("Fig. 4 shows the radial lens distortion profiles estimated during the pre- (solid lines) and post-flight (dashed lines) calibration for the ***nadir camera*** and the oblique camera. The digital camera calibration results agree with a previous work reported… especially for the ***nadir camera*** typically equipped with a 28-mm lens."), 9 ("The GPS/INS interpolated position and attitude angles at each exposure station were used together with the

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imagery to analyse the system performance when using ***nadir*** plus oblique ***images***. After preprocessing the GPS/INS data to compensate for the position and orientation offsets between the navigation and imaging sensors, the compensated position and attitude parameters were used as observable exterior orientation parameters (in M-frame) together with their standard deviations and the image point measurements from the commercial software package PCI OrthoEngine."), 10 ("The analysis was done as follows: using a stereopair of ***nadir images***; using a stereopair of ***nadir images*** plus an extra oblique image; using a ***strip of five nadir images***; using a strip of ***five nadir images*** plus extra oblique images as available; using a block of 3 X 3 ***nadir images***; and using a block of 3 X ***3 nadir images*** and oblique images in addition to cross strips in both directions.") Fig.6 (showing "nadir digital image" on the left):

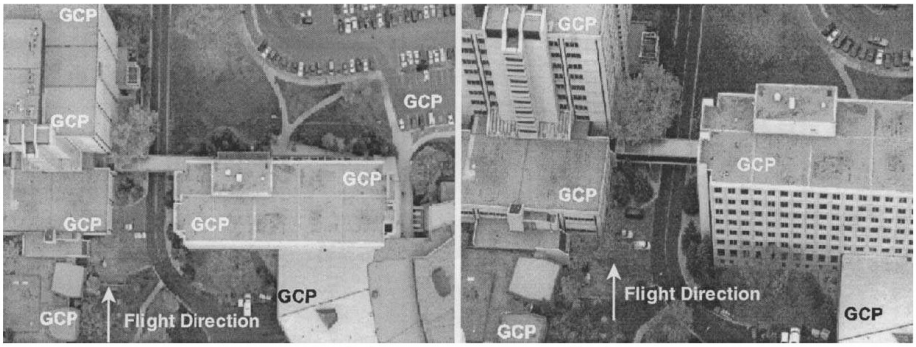


Fig. 6. A nadir digital image (left) and an oblique digital image (right), October 1998 flights.

321. In my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement one of the multiple still cameras of Loewen-Fujimoto, which relies on Loewen's disclosures of**

capturing oblique aerial images using, *e.g.*, two "still, digital cameras," and capture of orthogonal images using, *e.g.*, a video camera "arranged at 90 degrees" for, *e.g.*, "filming the right-of-way" (*e.g.*, EX1004 (Loewen), 2:30-36, 5:38-42, 5:62-6:2 ("number and arrangement of cameras can vary"), 8:8-14, 8:54-57) using Mostafa's advantageous disclosure of a downward-facing still camera (*e.g.*, "nadir," EX1007 (Mostafa), Abstract) in place of Loewen's downward-facing video camera. Using a downward-facing still camera, as expressly disclosed by Mostafa (*e.g.*, EX1007 (**Mostafa**), Abstract), to take periodic orthogonal still photographs (triggered by, *e.g.*, Loewen's laser altimeter detecting an object in the right-of-way and sending a signal to Loewen's onboard computer, which in turn triggers the image-capturing devices (*see* ¶¶182-184), or configured to capture still images at set intervals rather than continuous, memory-intensive video recordings), rather than a downward-facing video camera, would have reduced the memory used by the system by replacing memory-intensive video recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Moreover, Mostafa expressly discloses that the use of a nadir digital still camera "allows for covering the same ground scene with a nadir and an oblique image that, when simultaneously processed, provides a

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wider intersection angle and thus better height accuracy." *E.g.*, EX1007 (**Mostafa**), 4. Using a still camera rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004 (**Loewen**), 2:19-21. This would have advantageously enabled the combined system to provide higher accuracy, more detailed images of captured structures (including as to the height of any transmission towers to ascertain whether such towers are leaning or their foundations have settled), the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

322. Thus, in my opinion, Loewen discloses or at minimum renders obvious the additional limitation of claim 20.

323. Accordingly, in my opinion, claim 20 is rendered obvious over Loewen in view of Fujimoto.

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K. Claim 21 Is Rendered Obvious Over Loewen in view of Fujimoto, or Alternatively, Loewen in view of Fujimoto and Mostafa (Grounds 1 and 4)

324. **In my opinion, Claim 21 is rendered obvious over Loewen in view of Fujimoto (Ground 1), or alternatively, Loewen in view of Fujimoto and Mostafa (Ground 4).** *See infra*, Appendix C, Claim 21.

325. Claim 21 recites "**The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the computer system transmits image-capture signals to the first image-capturing device and the second image-capturing device and the third image-capturing device to cause the first, second, and third image-capturing devices to capture images.**"

326. In my opinion, **Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa render obvious the system for capturing images and geo-location data corresponding thereto of claim 20** (*see* cl.20)**, wherein the computer system** (*see* cl.1.d-cl.1.f (rendered obvious by Loewen in view of Fujimoto)) **transmits image-capture signals to the first image capturing device and the second image-capturing device** (*see* cl.1.a-cl.1.b (disclosed by Loewen)) **and the third image-capturing device** (*see* cl.20 (rendered obvious by Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa)) **to cause the first, second, and third image capturing devices to capture images** (*see* cl.1.f, cl.20)**.**

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327. To clarify, claim 1 requires that the computer system requires transmitting image-capture signals to the first and second image-capturing devices, which is disclosed by Loewen. *See* cl.1.a-cl.1.b. Further, the mapping provided above for claim 1 confirms that Loewen discloses a third image-capturing device (although that is not required by claim 1, itself). Claim 20 depends from claim 1 and 14, and requires a third image-capturing device capturing orthogonal images. As shown above, claim 20 is rendered obvious over Loewen in View of Fujimoto, or alternatively, Loewen in View of Fujimoto and Mostafa. With respect to the added requirement in claim 21, which depends from claim 20, and requires that the computer system send an image-capturing signal to the third image-capturing device, as discussed below (and in cl.1), Loewen expressly discloses or renders obvious transmitting image-capturing signals to each of its image-capturing devices (*i.e.*, all three devices addressed in claim 20 and claim 1). Additionally, Loewen in view of Mostafa also renders obvious transmitting image-capturing signals to each of its image-capturing devices. *See* cl.5, cl.20.

328. As an initial matter, I note that while this claim does not require independent camera control of the third camera, Fujimoto discloses independent camera control for at least four cameras and would render this limitation obvious if independent third camera control were required for the same reasons detailed above. *See* cl.1.f; EX1005 (**Fujimoto**), ¶0008, Fig.2.

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329. In my opinion, POSITA would have understood that Loewen expressly discloses transmitting image-capture signals to each of its image-capturing devices to cause each image-capturing device to capture images. Indeed, Loewen expressly discloses "triggering the still cameras" and "tripping the shutters" (in response to, *e.g.*, Loewen's laser altimeter detecting an object in the right-of-way and sending a signal to Loewen's onboard computer, which in turn triggers Loewen's image-capturing devices (*see* ¶¶182-184), or configured to capture still images at set intervals rather than continuous, memory-intensive video recordings), and that "the computer is then able to perform real time coordination of camera tripping." EX1004 (**Loewen**), 6:51-54, 7:13-17, 7:49-53. POSITA would have understood this to be an express disclosure of triggering all of Loewen's still cameras to capture images—which, as discussed (*see* cl.20) would have included a first, second, and third image-capturing device—by transmitting image-capturing signals to each camera, thus satisfying this limitation.

330. To the extent it is argued that further disclosure of transmitting image-capture signals to the third image-capturing device to cause the third image-capturing device to capture images is required, in my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed transmission of image-capture signals to its first and second-image capture devices to further transmit an image-capture signal**

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to Loewen's third image-capture device, thus causing the third-image capture device to capture images. This would have advantageously provided imagery from a different viewpoint (orthogonal), which, as discussed, would have increased the usefulness of the system by providing still imagery from an additional viewpoint, thus providing the user of the system with additional views of and information about the structures or areas of interest being captured by the system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

331. **In my opinion, Loewen in view of Mostafa also renders this limitation obvious (Ground 4)**. As discussed (*see* cl.20), Loewen in view of Mostafa renders obvious a third image-capturing device. To the extent it is argued that further disclosure of transmitting image-capture signals to the third image-capturing device to cause the third image-capturing device to capture images is required, in my opinion, **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed transmission of image-capture signals to its first and second-image capture devices to further include transmitting a third image-capture signal to the combined Loewen-Fujimoto-Mostafa system's third (orthogonal) image-capture device, thus causing the third-image capture device to capture images.**

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This would have advantageously provided imagery from a different viewpoint (orthogonal), which, as discussed, would have increased the usefulness of the system by providing still imagery from an additional viewpoint, thus providing the user of the system with additional views of and information about the structures or areas of interest being captured by the system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

332. Thus, in my opinion, Loewen in view of Fujimoto, or alternatively, Loewen in view of Fujimoto and Mostafa renders obvious the additional limitation of claim 21.

333. Accordingly, in my opinion, claim 21 is rendered obvious over Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa.

L. Claim 26 Is Rendered Obvious Over Loewen in View of Fujimoto and Kain 1997, or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 1997 (Grounds 3 and 5)

334. **In my opinion, Claim 26 is rendered obvious over Loewen in view of Fujimoto and Kain 1997 (Ground 3), or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 1997 (Ground 5).** *See infra*, Appendix C, Claim 26.

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335. Claim 26 recites "**The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the first and second image-capturing devices capture community level oblique aerial images.**" **In my opinion, Loewen in view of Fujimoto and Kain 1997 (Ground 3), or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 1997 (Ground 5) renders obvious this limitation.**

336. In my opinion, **Loewen in view of Fujimoto and Kain 1997, or Loewen in view of Fujimoto, Mostafa, and Kain 1997 render obvious the system for capturing images and geo-location data corresponding thereto of claim 20** (*see* cl.20)**, wherein the first and second image-capturing devices** (*see* cl.1a-1.b (citing Loewen)) **capture community level oblique aerial images**[26] (*see* cl.4 (discussing "first or second image-capturing device captures community level oblique aerial images"), cl.20 (discussing "first and second image-capturing devices are capturing oblique aerial images"))**.**

337. To clarify, claim 20, on which claim 26 depends, is rendered obvious based on Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa. Claim 26 additionally requires that the first and second image-capturing devices (disclosed by Loewen, *see* cl.1.a-1.b) capture community level oblique aerial

[26] *See* ¶130.

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images. Claim 4, above, explains how Loewen in view of Fujimoto and Kain 1997 renders obvious a first *or* second image capturing device capturing community level oblique ariel images. Claim 20, above, explains how Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa renders obvious the first and second image-capturing devices capturing oblique aerial images. The additional limitations of claim 21 require that the *both* the first and second image-capturing devices that capture oblique aerial images (as mapped in claim 20) do so at a community level (as mapped in claim 4 in connection with at least one of the cameras). This combination, resulting in first and second image-capturing devices that capture community level oblique aerial images, is discussed below.

338. As an initial matter, I note that claim 4 requires the "first ***or*** second image-capturing devices" capture "community level oblique aerial images" whereas claim 20 requires both the first ***and*** second image-capturing devices to capture oblique aerial images. As discussed immediately below, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed first and second image-capturing devices that capture oblique aerial images such that both image-capturing devices capture community level oblique aerial images.

339. In my opinion and as discussed above (*see* cl.4), **POSITA would have been motivated and found it obvious, straightforward, and advantageous to**

implement the disclosed first and second image-capturing devices of the Loewen-Fujimoto system or the Loewen-Fujimoto-Mostafa system of claim 20 that capture oblique aerial images (*see* cl.20) using Kain's advantageous disclosure of capturing images including one foot per pixel image resolution (*see* cl.4), which POSITA would have understood is a community-level aerial image consistent with the '657 patent's explanation of that term, such that the first and second image-capturing devices in the resulting system captured community-level oblique aerial images (triggered by, *e.g.*, Loewen's laser altimeter detecting an object in the right-of-way and sending a signal to Loewen's onboard computer, which in turn triggers the image-capturing devices (*see* ¶¶182-184), or configured to capture still images at set intervals rather than continuous, memory-intensive video recordings) in appropriate contexts, including for larger structures where small detail is of less concern, such as photographing the right-of-way, *i.e.*, the path defined by the tower structures and the transmission cables between towers, "to inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees and other plant growth or the like have encroached into the right-of-way and is presenting a potential interference with the transmission line," and to "provide aerial images of ground structures… roadways and the like." *E.g.*, EX1004 (**Loewen**), 2:23-26, 5:37-41; *see also id.* at 2:19-21 ("Another objective of this invention is to provide a reliable and accurate record of the right-of-way of an

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electric transmission line, and to do so in **a cost-effective manner**."). Capturing community-level oblique aerial images of one-foot per pixel in the foreground of the image (in contexts, as noted above, where higher-resolution images are not required, such as capturing the right-of-way or roadways or identifying downed transmission towers following a severe storm), two-feet per pixel in the mid-ground, and four-feet per pixel in the background (*see* ¶275) using both the first and second image-capturing devices (which Loewen expressly discloses would have advantageously allowed one camera to be oriented to capture landscape-type images and the other camera to capture portrait photographs (*e.g.*, EX1004 (**Loewen**), 11:36-40)) would have advantageously reduced storage requirements as compared to images captured at a higher-resolution, thereby allowing for a greater number of images to be captured and stored while still providing sufficient detail for various uses of such imagery including, *e.g.*, to identify downed transmission towers following a severe storm (which would require less detailed imagery). Allowing for a greater number of images to be captured would have, *e.g.*, advantageously allowed for more views of the structures or areas of interest and/or more structures or areas of interest to be captured by the combined system in a single flight, thus increasing the coverage of the capture system. For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images of different resolution was well-known and conventional by varying well-known camera

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parameters (*e.g.*, field of view, sensor size) and distance from which an image is taken, and clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

340. Thus, in my opinion, Loewen in view of Fujimoto and Kain 1997, or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 1997 renders obvious the additional limitation of claim 26.

341. Accordingly, in my opinion, claim 26 is rendered obvious over Loewen in view of Fujimoto and Kain 1997, or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 1997.

M. Claim 27 Is Rendered Obvious Over Loewen in View of Fujimoto and Kain 2003, or Alternatively, Loewen in View of Fujimoto, Mostafa, and Kain 2003 (Grounds 6 and 7)

342. **In my opinion, Claim 27 is rendered obvious over Loewen in view of Fujimoto and Kain 2003 (Ground 6), or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 2003 (Ground 7).** *See infra*, Appendix C, Claim 27.

343. Claim 27 recites "**The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the first and second image-capturing devices capture neighborhood level oblique aerial images.**" **In my opinion, Loewen in view of Fujimoto and Kain 2003 (Ground 6), or**

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alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 2003 (Ground 7) renders obvious this limitation.

344. In my opinion, **Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa renders obvious the system for capturing images and geo-location data corresponding thereto of claim 20** (*see* cl.20)**, and Loewen discloses wherein the first and second image-capturing devices captures oblique aerial images**[27] (*see* cl.1.a, cl.20 (citing Loewen))**.**

345. **Kain 2003 discloses capturing neighborhood-level aerial images** (*e.g.*, "image" with "ground-sample-distance" of "0.196 ft" (approximately 2.3 inches) or "0.391 ft" (approximately 4.69 inches))**.**

346. As an initial matter, I note that the '657 patent states "neighborhood level[] is significantly more detailed than the community-level images" and "[o]blique neighborhood-level images have a ground sample distance of, for example, from approximately four-inches per pixel in the foreground of the image to approximately six-inches per pixel in the midground of the image, and to approximately 10 inches per pixel in the background of the image." EX1001, 13:65-9. POSITA would have understood from this exemplary, non-limiting description of certain oblique neighborhood level-images, and particularly its statement that

[27] *See* ¶130.

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neighborhood-level images are "significantly more detailed than… community-level images" and the fact that '657 does not describe a category with an even more detailed level of imagery, that oblique aerial images including other lower ground sample distances (which denote a higher resolution) would also qualify as "neighborhood level oblique aerial images" as that term is used in '657. As discussed (*see* ¶349, *infra*) POSITA would have thus understood that Kain 2003 expressly disclosed neighborhood-level aerial images.

347. In my opinion, **Kain 2003 discloses capturing neighborhood-level aerial images** (*e.g.*, "image" with "ground-sample-distance" of "0.196 ft" (approximately 2.3 inches) or "0.391 ft" (approximately 4.69 inches))**.**

348. As an example of its disclosure of neighborhood-level aerial images, Kain Table 3 discloses a ground sample distance ("GSD") of 0.196 feet per pixel (approximately 2.3 inches) at an altitude of 500 feet and 0.391 feet per pixel (approximately 4.69 inches) at an altitude of 1000 feet.

TABLE 3

Altitude (AGL ft)	GSD (m/ft)	Image Width (m/ft)	Image height (m/ft)	Area (acre/mi^2)
500	0.060/0.196	76.3/250.3	56.7/186.0	1.1/0.0017
1000	0.119/0.391	152.6/500.5	113.4/372.0	4.3/0.0067

TABLE 3-continued

Altitude (AGL ft)	GSD (m/ft)	Image Width (m/ft)	Image height (m/ft)	Area (acre/mi^2)
2000	0.238/0.782	305.1/1001.0	226.8/744.1	17.1/0.0267
3000	0.357/1.173	457.7/1501.5	340.2/1116.1	38.5/0.060
4000	0.477/1.564	610.2/2002.0	453.6/1488.1	68.4/0.107
6000	0.715/2.346	915.3/3003.1	680.4/2232.2	153.9/0.240
8000	0.953/3.128	1220.4/4004.1	907.2/2976.3	273.6/0.427
10000	1.192/3.910	1525.6/5005.1	1134.0/3720.3	427.5/0.668

349. It is also my opinion that POSITA would have understood that Kain 2003 expressly discloses an image including a ground sample distance of approximately 1.03 inches per pixel at 220 feet (an altitude expressly disclosed by Loewen (aircraft that flies approximately 100 feet above 120-foot-tall transmission towers (*e.g.*, EX1004 (**Loewen**), 5:14-15, 5:57-61))) and an image including a ground sample distance including 4 inches per pixel at approximately 841 feet, which POSITA would have been able to readily ascertain using simple ratios (*i.e.*, multiplication and division) based on Kain 2003's other expressly-disclosed ground-sample distance values at other altitudes such as 500 feet and 1000 feet. *E.g.*, EX1009 (**Kain 2003**), Table 3.

350. To the extent it is argued further disclosure of ground sample distances including 4 inches per pixel at lower altitudes, such as 220 feet, is required, in my opinion **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Kain 2003's expressly-disclosed 4 inches per pixel ground sample distance at approximately 841 feet at, instead, lower altitudes such as 220 feet** for appropriate applications, as doing

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so would have allowed for the capture of higher resolution images at lower altitudes that would be more likely to be below cloud cover, thereby increasing visibility and allowing the capture of images on many more days per year (as opposed to only on days without significant cloud cover for systems that capture at higher altitudes). Moreover, Loewen expressly discloses that the user of lower altitudes allows "the use of advantageous exposure parameters (shutter speed, lens opening and resulting depth of field) for the cameras." *E.g.*, EX1004 (**Loewen**), 2:53-56. For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images at different resolutions was well-known and conventional and could be easily done by varying well-known camera parameters (*e.g.*, field of view, sensor size) and clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

351. In addition, it is my opinion that **POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed first and second image-capturing devices that capture oblique aerial images (in the combined Loewen-Fujimoto or Loewen-Fujimoto-Mostafa systems (*see* cl.20)) using Kain 2003's advantageous disclosures of neighborhood-level aerial images including ground sample distances of, *e.g.*, 1.03 inches per pixel, 2.3 inches per pixel, 4 inches per pixel, and 4.69 inches per pixel in, for example, the foreground, with increasing values (*i.e.*, lower**

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resolutions) in the mid-ground and background due to Loewen's expressly disclosed camera angles ranging from 30-60 degrees including, preferably, 45 degrees (*see* ¶¶124-130; *see also, e.g.*, EX1009 (Kain 2003), ¶39 ("actual achieved ground-sample distance is slightly higher than the ground-sample distance at the center pixel of the camera due to the geometry") and what POSITA would have understood were fields of view at the upper end of the range of conventional and well-known fields of view, which POSITA would have understood are oblique neighborhood-level images. *See* **¶¶124-130**. POSITA would have understood that capturing more detailed neighborhood-level oblique aerial images including ground sample distances of, *e.g.*, four inches per pixel in the foreground of the image would have produced images of a higher resolution, advantageously allowing for more highly detailed views of structures or areas of interest, such as detailed views of transmission towers, wire attachment points to those towers, and of wires themselves, thus increasing the usability of images captured with the combined system. *E.g.*, EX1004 (**Loewen**), 2:34-36 ("capture high resolution images of the electric transmission line tower structures and equipment attached to those towers"). For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images of higher resolution was well-known and conventional and could be easily done by varying well-known camera parameters (*e.g.*, field of view, sensor size) and distance

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from which an image is taken—*e.g.*, it would have been beneficial to operate the combined system at higher altitudes to, for example, better capture downed transmission towers or scattered wires following a severe storm that would otherwise not be fully visible from, *e.g.*, 80-100 feet above intact transmission towers (which Loewen discloses are from 80-120 feet high (*e.g.*, EX1004 (**Loewen**), 5:14-15)) or to capture images at a higher altitude where required by flight regulations that do not permit lower-altitude flights over certain areas such as powerplants, where transmission towers are likely to be located)—and clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* ¶193.

* * *

352. Thus, in my opinion, Loewen in view of Fujimoto and Kain 2003, or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 2003 renders obvious the additional limitation of claim 27.

353. Accordingly, in my opinion, claim 27 is rendered obvious over Loewen in view of Fujimoto and Kain 2003, or alternatively, Loewen in view of Fujimoto, Mostafa, and Kain 2003.

VIII. SECONDARY CONSIDERATIONS

354. At this time, including after review of the documents and materials cited herein, those identified in the list of exhibits above, those identified in

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Appendix C, and those identified by Patent Owner, there is no evidence of secondary considerations, and it is my opinion that each of the Challenged Claims of the '657 patent is obvious over the prior art. I have been advised that Patent Owner has not provided any evidence of secondary considerations of non-obvious with a nexus to (and thus relevant to) the '657 patent. I understand that if the Patent Owner presents additional, relevant evidence of objective factors that it argues supports a finding of non-obviousness, I may be asked to review such evidence and to formulate an opinion and reserve the right to address any such evidence and/or arguments that Patent Owner may raise in this regard.

IX. CONCLUSION

355. In summary, for the reasons described above and in Appendix C, I have concluded that each of the Challenged Claims is invalid as obvious under 35 U.S.C. § 103 in light of the prior art references discussed above and the knowledge of POSITA.

356. Specifically it is my opinion that **Ground 1**: Claims 1, 5, 14, 19, 20, and 21 are rendered obvious over Loewen in view of Fujimoto; **Ground 2**: Claims 2 and 3 is rendered obvious over Loewen in view of Fujimoto, Garrot, and Mostafa; **Ground 3**: Claims 4 and 26 are rendered obvious over Loewen in view of Fujimoto and Kain 1997; **Ground 4**: Claims 5, 19, 20, and 21 are rendered obvious over Loewen in view of Fujimoto and Mostafa; **Ground 5**: Claim 26 is rendered obvious

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over Loewen in view of Fujimoto, Mostafa, and Kain 1997; **Ground 6:** Claim 27 is rendered obvious over Loewen in view of Fujimoto and Kain 2003; **Ground 7**: Claim 27 is rendered obvious over Loewen in view of Fujimoto, Mostafa, and Kain 2003.

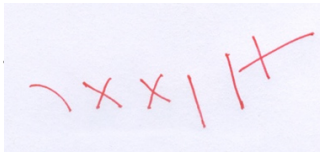
357. To the extent it is argued that any further disclosure is required for any of the limitations in the Challenged Claims that I have identified herein as being disclosed, either explicitly or inherently, by the references listed in Appendix C, POSITA would certainly have found that limitation obvious to include based on the same explicit disclosure or inherent disclosures and analysis I have identified in my declaration.

358. I reserve the right to supplement by opinions in the future and to respond to any arguments that Patent Owner or its expert(s) may raise and to take into account any new information as it becomes available to me.

359. I have been warned that willful false statements and the like are punishable by fine or imprisonment, or both. I make this declaration of my own personal knowledge, and all statements made of my own knowledge are true. All statements made on information and belief are believed to be true. If called to testify as to the truth of the matters stated herein, I could and would testify competently.

I declare under penalty of perjury that the foregoing is true and correct.

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Executed on March 27, 2024 at Urbana, Illinois 

David A. Forsyth, D.Phil.

APPENDIX A

Curriculum Vitae: D.A. Forsyth

Birth

2 May, 1963, Cape Town, South Africa.

Degrees

1. B.Sc., Electrical Engineering, U. of the Witwatersrand, Johannesburg, 1984
2. B.Sc., Electrical Engineering, U. of the Witwatersrand, Johannesburg, 1986
3. M.A., (procedural degree), Oxford University, 1989
4. D.Phil., Oxford University, 1989

Appointments

1. Fellow, Magdalen College, Oxford, Jan. 1989-Jan. 1992
2. Assistant Professor, Dept. of Computer Science, U. of Iowa, Sept. 1991-Jul. 1994
3. Associate Professor, Dept. of Computer Science, U. of Iowa, July 1994-Jul. 1996
4. Assistant Professor, Dept. of Computer Science, U. of California, Berkeley, Jul. 1994-Jun. 1996
5. Associate Professor, Dept. of Computer Science, U. of California, Berkeley, Jul. 1996-Jun. 2002
6. Full Professor, Dept. of Computer Science, U. of California, Berkeley, Jul. 2002-Jun 2006
7. Full Professor, Dept. of Computer Science, U. of Illinois, Aug. 2004-Present
8. Fulton Watson Copp Chair in Computer Science, U. of Illinois, May 2014-Present

Honors and Awards

1. Diocesan College Rhodes Scholar, 1985
2. National Science Foundation Research Initiation Award, 1992
3. National Science Foundation Young Investigator Award, 1992
4. Marr Prize, Best Paper at 1993 ICCV, 1993
5. Best Paper in Cognitive Computer Vision, ECCV, 2002
6. Okawa Foundation Fellowship, 2003
7. IEEE Technical Achievement Award, 2006
8. IEEE Fellow, 2009
9. ACM Fellow, 2014

Consulting Activities

1. Consultant, intellectual property law firm, 65 hours billed, 1998-99
2. Consultant on retainer, FujiFilm Software CA, 2001-2006
3. Consultant, venture capital firm, 3 hours billed, 2002
4. Consultant, intellectual property law firm, 13 hours billed, 2003
5. Consultant, State's attorney's general, 1 hour, 2006
6. Technical Advisor, Euclid Media, 2007-2008
7. Technical Advisor, Animate-me, 2007-2008, helped them get NSF SBIR award.

8. Technical Advisor, Snap-and-buy, 2007-2008
9. Technical Advisor, Lumenous, 2015-present, helped them get NSF SBIR award.
10. Technical Advisor, Depix, 2020-present
11. Technical Advisor, Revery.ai, 2020-present
12. Consultant, Foley+Lardner, 2009-2010
    including reading and report preparation, 10 hours deposition, attendance at trial, about 4 hours direct examination at trial, about 2 hours cross examination at trial. Matter was 337-TA-680 in the ITC
13. Consultant, Sheridan and Ross (IP law firm), 2012-2013;
    including reading, search and report preparation; district court case number 6:11-cv-00494
14. Consultant, Fish and Richardson, 2014-2015
    including reading and report preparation, deposition in IPR invalidity, deposition on non-infringement, presenting to district court judge on technical tutorial. Matter was IpLearn-Focus, LLC vs Microsoft Corp, district court case number 3:14-cv-00151-JD. IPR's were IPR2015-00095; IPR2015-00096; IPR2015-00097.
15. Consultant, Irell and Manella, 2016-2018
    including reading, search and report preparation; 3 full day depositions; IPR petitions*; Legend3D, Inc. v. Prime Focus Creative Services Canada Inc.,* IPR2016-00806; *Prime Focus Creative Services Canada Inc. v. Legend3D, Inc.*, IPR2016-01243; and *Prime Focus Creative Services Canada Inc. v. Legend3D, Inc.*, IPR2016-01491. Parties were: Legend 3D and Prime Focus Creative Services Canada
16. Consultant, Klarquist Sparkman, 2019-current
    Including reading, search and report preparation for invalidity and non-infringement, for district court matter. 1 full day deposition. Kewazinga Corp. v. Microsoft Corporation, Southern District of New York, 1:2018-cv-04500 (SDNY)
    Parties were: Microsoft Inc. and Kewazinga Corp.
17. Consultant, Scientific Advice to Apple, 2021
18. Consultant, Kerr, Russell and Weber,
    2020-2022, Parties were Innovision and Autis: engaged, but only 1 hr work done.,
19. Consultant, Oblon, 2021,
    Parties were: Eagle View Technologies Inc.; Pictometry International Corp; Nearmap US Inc; Nearmap Australia, Pty, Ltd and Nearmap Ltd)
21. Consultant, Tensegrity Law group, 2021
    Parties were: Facebook, Inc.; MTA Platforms, Inc; Instagram LLC; Whatsapp, Inc; Eyesmatch, Ltd; Memomi Labs, Inc. The activities involved preparing materials for IPRs involving U.S. Patent Nos. 7,948,481, and 8,624,883
22. Consultant, Quinn Emannuel, 2021
    The matter was: Certain Barcode Scanners, Mobile Computers with Barcode Scanning Capabilities, Scan Engines, and Components Thereof (Inv. No. 337-TA-1285); Honeywell Int'l Inc., Hand Held Products, Inc., and Metrologic Instruments, Inc. v. Zebra Techs. Corp., Civil Action No. 6:21-cv-01008-ADA; Honeywell Int'l Inc., Hand Held Products, Inc., and Metrologic Instruments, Inc. v. Zebra Techs. Corp., Civil Action No. 6:21-cv-01010-ADA;
23. Consultant, Fish and Richardson, 2022-present
    Including reading, search, report preparation and deposition for five IPR's:
    IPR2022-00733, IPR2022-00734, IPR2022-00735, IPR2022-01090, IPR2022-01009
    Parties are: Eagle View Technologies Inc.; Pictometry International Corp; Nearmap US Inc; Nearmap Australia, Pty, Ltd and Nearmap Ltd)
24. Consultant, Groombridge Wu, present
    Parties are: Eagle View Technologies Inc.; Pictometry International Corp; Nearmap US Inc; Nearmap Australia, Pty, Ltd and Nearmap Ltd)
25. Consultant, Tensegrity, present
    Parties are: Eyesmatch Ltd; Samsung Electronics, Ltd

Graduated PhD Students

1. C.A. Rothwell (co advised with A. Zisserman)
2. J.Haddon
3. F.S.Cho
4. S.J. Chenney
5. S.Ioffe
6. P.Duygulu (co-advised)
7. O.Arikan
8. D.Ramanan
9. T.Berg (nee Miller)
10. J.Edwards
11. R.White
12. L.Ikemoto
13. N.Loeff
14. A.Farhadi
15. D.Tran
16. A.Sorokin
17. G.Wang
18. V.Hedau (joint with D. Hoiem)
19. B.Jones (joint with B. Bailey)
20. R.Sodhi (joint with B. Bailey)
21. K.Karsch
22. A.Sadeghi
23. Z.Liao
24. S. Singh
25. D. Tsatsoulis
26. J. Lu
27. J. Rock
28. A. Deshpande
29. M. Vasileva
30. D. Roberts (joint with M. Golparvar Fard)
31. T. Issaranon
32. M-J. Chong
33. Anand Bhattad
34. Kedan Li

Editorial Boards

1. Associate Editor, IEEE Trans. Multimedia
2. Editorial Board, Int. J. Computer Vision
3. Associate Editor, IEEE Trans Pattern Analysis and Machine Intelligence, 2 terms
4. Associate Editor, J. ACM, since 2011
5. Associate Editor, ACM Transactions on Graphics, since 2011
6. Editor in Chief, IEEE Trans. Pattern Analysis and Machine Intelligence, 2013-2017

Service and Administration

1. Committee member, U.C. Berkeley Committee on Admissions, Enrollment and Preparatory Education, 1995-2001 (Dealt with the University's response to the UC Regents order on affirmative action; established now well-known new admission policy for UC Berkeley, currently being taken up by other UC campuses).
2. Committee member, U.C. Berkeley Rhodes and Marshall Scholarship Committee, 1999-2003.
3. Member, National Research Council Committee on Tools and Strategies for Protecting Kids from Pornography and Their Applicability to Other Inappropriate Internet Content. (3 years of hearings, both closed and public, and an extensive report that was very well received by the popular press)
4. Founder and Member, Executive Committee of the Board, Berkeley Foundation for Opportunity in Information Technology. (Foundation seeks to ensure that Demographics of California University Computer Science Departments reflects that of the state, by helping targeted schoolchildren improve their understanding of science and their college application packets; by offering scholarships; and by various other means.)
5. Program Co-Chair: ECCV2008, CVPR 2000, CVPR2011, CVPR2018, CVPR2021, ICCV2025
   (Note: For vision conferences, program chairs cannot submit papers; PC is a major administrative task; CVPR2018 had approx. 5000 submissions and CVPR 2021 had approx. 7000 submissions)

6. General Co-Chair: CVPR2006, CVPR2015, ICCV2019
7. Senior Advisor to Program Chairs: CVPR2024
8. Associate Department Chair, UIUC CS Department, 2011-2015
9. Adjunct Professor, TTIC, 2015-ongoing
10. Scientific Advisory Board, Allen Institute for Artificial Intelligence, 2015-to date
11. Scientific Advisory Board, KAUST Visual Computing Institute, 2016
12. Scientific Advisory Board, Baidu Research, 2017-2022
13. Editor in Chief, IEEE Trans. Pattern Analysis and Machine Intelligence, 2013-2017
14. Committee member, UIUC Senate Committee on Student Discipline, 2017-present
15. Ombud, CVPR, 2018-present
16. Member, 8'th Senate review commission, UIUC 2018-2019
17. Chair, UIUC Senate committee for Academic Freedom and Tenure, 2020-present
    Duties included: Significant Article X Hearing (40 hours of testimony) and managing difficult academic freedom disputes
18. Technical Advisory board, Depix, 2019-present
19. Scientific advisor, Revery.ai, 2020-present
20. Moderator for Computer Vision, ArXiV, 2017(?)-present
21. Chair, search committee for EIC IEEE TPAMI, 2021

US Patents

1. US 9330500 B2 Inserting objects into content, Kevin Karsch, Varsha Chandrashekhar Hedau, David A. Forsyth, Derek Hoiem
2. US 8842118 B1 Automated image replacement using deformation and illumination estimation, Ryan White, David Forsyth
3. US 9,471,967, Relighting Fragments For Insertion Into Content, Kevin Karsch, Zicheng Liao, David Forsyth,

Publications

Authored books

1. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach*, Prentice-Hall, 2002.
2. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach,* 2002. Chinese Language Edition
3. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach*, 2002. Russian Language Edition
4. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach*, 2002. Japanese Language Edition
5. Forsyth, D.A., Arikan, O., Ikemoto, L., O'Brien, J., and Ramanan, D., *Computational Studies of Human Motion: Part 1, Tracking and Motion Synthesis,* ISBN: 1-933019-30-1 178pp July 2006 (also available as *Foundations and Trends in Computer Graphics and Vision Volume 1* Issue 2/3 (255pp), 2006)
6. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach* (2e), Prentice Hall, 2011 (heavily revised edition, about 50% new material)
7. Forsyth, D.A., *Probability and Statistics for Computer Science*, Springer Verlag, 2018
8. Forsyth, D.A., *Applied Machine Learning*, Springer Verlag, 2019

Edited books

1. *Computer Vision - ECCV 2008. 10'th European Conference on Computer Vision, Part I,* D.A. Forsyth, P.H.S. Torr and A. Zisserman, Springer Verlag LNCS 5302, 801 pp, 2008
2. *Computer Vision - ECCV 2008. 10'th European Conference on Computer Vision, Part II*, D.A. Forsyth, P.H.S. Torr and A. Zisserman, Springer Verlag LNCS 5303, 851pp., 2008
3. *Computer Vision - ECCV 2008. 10'th European Conference on Computer Vision, Part II,* D.A. Forsyth, P.H.S. Torr and A. Zisserman, Springer Verlag LNCS 5304, 893pp., 2008
4. *Computer Vision - ECCV 2008. 10'th European Conference on Computer Vision, Part II,* D.A. Forsyth, P.H.S. Torr and A. Zisserman, Springer Verlag LNCS 5305, 827pp., 2008
5. *Applications of Invariance in Computer Vision,* J.L. Mundy, A. Zisserman and D.A. Forsyth, (ed.s), Springer LNCS 825, 1994.
6. *Shape, contour and grouping in computer vision,* D.A. Forsyth, J.L. Mundy, R. Cipolla and V. DiGes\'u (ed.s), Springer-Verlag LNCS 1681, 2000.

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1. Forsyth, D.A., "Colour constancy," in Blake, A. and Troscianko, T. (eds.), *AI and the Eye,* John Wiley and Sons, 1990.
2. A. Zisserman, C.A. Rothwell, D. A. Forsyth and J. L. Mundy, "Fast Recognition using Algebraic Invariants," in Mundy, J.L and Zisserman, A. (eds.), *Applications of Invariance in computer vision*, MIT press, 1992.
3. w A. Zisserman, D. A. Forsyth, C. A. Rothwell, and J. L. Mundy, "Recognising General Curved Objects Efficiently," in Mundy, J.L and Zisserman, A. (eds.), *Applications of Invariance in computer vision*, MIT press, 1992.
4. C. Coehlo, A. Heller, J.L. Mundy, D.A.Forsyth and A. Zisserman, "An experimental evaluation of projective invariants," in Mundy, J.L and Zisserman, A. (eds.), *Applications of Invariance in computer vision*, MIT press, in print, 1992.
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8. D.A. Forsyth, "Foreword", in H. Aghajan and A. Cavallero, *Multi-Camera Networks*, Elsevier, 2009
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11. D.A. Forsyth and J. Malik, " Computer Vision", in S.J. Russell and P. Norvig, Artificial Intelligence: A Modern Approach 4e, Pearson, 2020

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1. Forsyth, D.A., "A novel algorithm for colour constancy," *International Journal of Computer Vision,* 5:1, 5-36, July, 1990. Reprinted in *Physics based vision* (3 vols.), edited by S.A. Shafer, G. Healey, and L.B. Woolff, 1992.
2. Forsyth, D.A. and Zisserman, A., "Shape from shading in the light of mutual illumination," *Image and Vision Computing*, 8:1, 42-49, 1990.
3. Forsyth, D.A., Mundy, J.L., Zisserman, A.P.. and Brown, C.M., "Projectively Invariant Representations Using Implicit Algebraic Curves," 9:2, 130-136, 1991.
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7. Rothwell, C.A., Zisserman, A.P., Marinos, C.I., Forsyth, D.A. and Mundy, J.L., "Relative motion and pose from arbitrary plane curves," *Image and Vision Computing*, 10:4, 250-262, 1992.
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17. Forsyth, D.A., Haddon, J., and Ioffe, S., "The Joy of Sampling," *International J. Computer Vision*, 41:1-2, 109-134, Jan. 2001.
18. O. Arikan and D.A. Forsyth, "Interactive Motion Generation from Examples," *Proc. SIGGRAPH*, 2002
19. O. Arikan, Forsyth, D.A., and J. O'Brien "Motion Synthesis from Annotations," *SIGGRAPH 2003*, San Diego, CA, Jul. 2003, in *ACM Transactions on Graphics*, vol. 33:3, 402-408, 2003
20. Barnard, K., Duygulu, P., Forsyth, D., de Freitas, N., Blei, D.M, Jordan, M. I., "Matching Words and Pictures," *Journal of Machine Learning Research*, 3(Feb):1107-1135, 2003.
21. Okan Arikan, David A. Forsyth, James F. O' Brien, "Fast and detailed approximate global illumination by irradiance decomposition," *ACM Transactions on Graphics (TOG) (SIGGRAPH 05)* Volume 24 , Issue 3 (July 2005)
22. A. Lobay and D.A. Forsyth, "Shape from Texture without Boundaries," *Int. J. Computer Vision*, 67, 1, 71-91, 2006
23. David A. Forsyth, Okan Arikan, Leslie Ikemoto, James O' Brien, Deva Ramanan, "Computational Studies of Human Motion: Part 1, Tracking and Motion Synthesis," Foundations and Trends in *Computer Graphics and Vision* Volume 1 Issue 2/3 (255pp), 2006 (also published in book form).
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27. T. Berg, A. Berg, R. White, E. Learned Miller, Y.W. The and D.A. Forsyth, "Names and Faces," accepted for publication, *IJCV* 2008
28. L. Ikemoto, O.Arikan and D.A. Forsyth, "Generalizing motion edits with Gaussian processes," *ACM Transactions on Graphics*, 2009
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33. Kevin Karsch, Varsha Hedau, Derek Hoiem and D.A. Forsyth, "Rendering Synthetic objects into Legacy Photographs", ACM Transactions on Graphics (Proc SIGGRAPH Asia), V 30, Issue 6, 2011
34. Gang Wang, Derek Hoiem, David Forsyth, "Learning Image Similarity from Flickr Groups Using Fast Kernel Machines," IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), Nov. 2012.
35. Zicheng Liao, Hugues Hoppe, David Forsyth, Yizhou Yu, A subdivision-based representation for vector image editing. IEEE Trans. Vis. Comput. Graphics, 18(11), Nov. 2012. (Spotlight Paper)
36. Yang Wang, Duan Tran, Zicheng Liao, D.A> Forsyth, Discriminative Hierarchical Part-based Models for Human Parsing and Action Recognition, J. Machine Learning Research 13 (Oct) 2012, 3075-3102
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42. Zicheng Liao, Kevin Karsch, Hongyi Zhang, D.A. Forsyth, "An Approximate Shading Model with Detail Decomposition for Object Relighting" Int. J. Computer Vision, 2018
43. D.A. Forsyth and Jason Rock, “Intrinsic Image Decomposition using Paradigms”, IEEE TPAMI, November, 2022
44. Xiaoyang Bai, Zhongmin Zhu, Alexander Schwing, David Forsyth, Viktor Gruev, “Angle of polarization calibration for omnidirectional polarization cameras” Opt Express. 2023 Feb 13;31(4):6759-6769.
45. Kedan Li, Jeffrey Zhang, David Forsyth, “POVNet: Image-Based Virtual Try-On Through Accurate Warping and Residual” IEEE Trans Pattern Anal Mach Intell, accepted for publication Jun 2023
46. Xiaoyang Bai, Zuodong Liang, Zhongmin Zhu, Alexander Schwing, David Forsyth & Viktor Gruev , "Polarization-based underwater geolocalization with deep learning", eLight volume 3, Article number: 15 (2023)
47. Y. Shen, B. Chandaka, Z-H. Lin, A. Zhai, H. Cui, D.A. Forsyth, S. Wang, “Sim-on-Wheels: Physical World in the Loop Simulation for Self-Driving”, IEEE Robotics and Automation Letters, Accepted for publication, 2023

Conference papers

1. s Forsyth, D.A., "Finding Changes in Colour," Proc. 1987 Alvey Vision Conference.
2. s Brady, J.M., Cameron, S.A., Durrant-Whyte, H., Fleck, M.M., Forsyth, D.A., Noble, J.A., and Page, I., "Progress towards a system that can acquire pallets and clean warehouses," Proc. ISRR, 1987.
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153. Anand Bhattad, Daniel McKee, Derek Hoiem, David Forsyth, "StyleGAN knows Normal, Depth, Albedo and more" ***NeurIPS***, 2023

154. Yuzheng Hu, Fan Wu, Qinbin Li, Yunhui Long, Gonzalo Garrido, Chang Ge, Bolin Ding, David Forsyth, Bo Li, Dawn Song , SoK: Privacy-Preserving Data Synthesis. 2024 IEEE Symposium on Security and Privacy (SP)

155. J. Zhang, S-Y. Chang, K. Li, D.A. Forsyth, Preserving Image Properties Through Initializations in Diffusion Models, Winter Conference on Applications of Computer Vision 2024.

156. K. Li, J. Zhang, S-Y. Chang, D.A. Forsyth, Controlling Virtual Try-on Pipeline Through Rendering Policies, Winter Conference on Applications of Computer Vision 2024.

157. M. J. Chong, K. K. Singh, Y. Li, J. Lu, D.A. Forsyth, P2D: Plug and Play Discriminator for accelerating GAN frameworks, Winter Conference on Applications of Computer Vision 2024

APPENDIX B

Exhibit	Description
EX1001	U.S. Patent No. 9,182,657
EX1002	U.S. Patent No. 9,182,657 File History
EX1004	U.S. Patent No. 7,184,072 (Loewen)
EX1005	EP0053640 (Fujimoto)
EX1006	U.S. Patent No. 5,878,356 (Garrot)
EX1007	Mostafa, M.M.R. & Schwarz, K.-P., "Digital image georeferencing from a multiple camera system by GPS/INS," ISPRS Journal of Photogrammetry & Remote Sensing, Vol.56, 1-12 (2001) (Mostafa)
EX1008	WO 97/35166 (Kain 1997)
EX1009	U.S. Patent Pub. No. 2003/0048357 (Kain 2003)
EX1010	U.S. Patent No. 7,893,957 (Peters)
EX1011	Hall, R.J. & Hiscocks, P., "A Microcomputer-Based Camera Control System," Photogrammetric Engineering and Remote Sensing, Vol.56 No.5, 443-446 (April 1990)
EX1012	Held, K.J. & Robinson, B, "TIER II Plus Airborne EO Sensor LOS Control and Image Geolocation," 1997 IEEE Aerospace Conference, Vol.2, 377-405 (1997)
EX1015	WO 99/18732 (Ciampa)
EX1016	U.S. Patent Pub. No. 2003/0164962 (Nims)
EX1017	"ISPRS Journal of Photogrammetry and Remote Sensing," https://www.sciencedirect.com/journal/isprs-journal-of-photogrammetry-and-remote-sensing/vol/56/issue/1
EX1018	"Nadir," "Merriam-Webster.com Dictionary," *available at* https://www.merriam-webster.com/dictionary/nadir (Accessed March 26, 2024)
EX1019	Compilation of Annotated Images from Oblique Aerials Browser, "A collection of historical aerial photographs of the City of Tampa," https://storymaps.arcgis.com/stories/f26b7c047dde45d6ae2224208d46071a (accessed March 27, 2024)
EX1021	Oblique Aerials Browser, "A collection of historical aerial photographs of the City of Tampa," https://storymaps.arcgis.com/stories/f26b7c047dde45d6ae2224208d46071a (accessed March 27, 2024)

APPENDIX C

Claim 1	Prior Art
[1.pre]: A system for capturing images and geo-location data corresponding thereto, comprising:	**Loewen in view of Fujimoto renders obvious claim 1.** **To the extent the preamble is limiting, Loewen discloses the preamble.** **Loewen discloses a system for capturing images** (*e.g.*, "system… for acquiring images of electric transmission line tower structures, equipment…, and transmission lines"; "airborne inventory and inspection system designed to obtain high resolution images… with a record of the respective location of the power line towers") **and geo-location data corresponding thereto** (*e.g.*, "laser altimeter or… GPS unit… supplies continuous longitude/latitude coordinates for the aircraft location" "GPS… continuously provides the position of the aircraft in longitude and latitude coordinates… [and] is embedded in the collected data in association with the image… recording… longitude/latitude coordinates in association with the image"; "height of the aircraft")**.** *See, e.g.*, EX1004, Abstract ("**A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software.** The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. **The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates.** The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed

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	downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees. The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. **The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way.**"), 1:16-24 ("**This invention relates to an airborne inventory and inspection system designed to obtain high resolution images of electric transmission power lines, the power line right-of-way and the support structure towers, along with a record of the respective location of the power line towers**, which system is an improvement over current accepted systems and can be performed at a cost that makes use of this system more cost effective than alternatives available to the electrical power transmission industry."), 2:22-25 ("More broadly, **it is among the objectives of this invention to provide aerial images of ground structures, apparatus, roadways and the like in an accurate, reliable and cost-effective manner**."), 2:30-38 ("For the achievement of these and other objects, **this invention proposes a system utilizing a fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images of the electric transmission line tower structures and equipment attached to those**

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	towers. Although this discussion will refer to **the use of plural cameras**, it will be appreciated that **this invention contemplates the use of one or more still cameras**."), 3:3-10 ("The still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device. **The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line.**"), 3:11-15 ("In one embodiment, the tower detecting device is in the form of a laser altimeter. **In an alternative embodiment, the system also contemplates the use of a GPS capability which cooperates in detecting the presence of a tower structure that is to be photographed.**"), 3:37-50 ("**The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates. In accordance with this system, that data is transmitted to the onboard computer and, in accordance with another aspect of this system, is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower.** This recording of the tower location in longitude/latitude coordinates in association with the image of each tower provides an inventory database of all of the towers along a particular transmission line. **The embedding of geographical location can be done in association with images captured by both the still and video cameras.**"), 3:51-57 ("**The still** and video **images, along with the geographic coordinates are transmitted to data storage units on board the aircraft for post processing or other future use as desired.** For example, post processing can be

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	visual inspection, tower by tower, on a suitable monitor for detection of structural defects."), 4:1-13 ("**When the alternative of preloaded longitude/latitude coordinates is used, the GPS unit is used in the activation of the still cameras. More particularly, the GPS continuously transmits longitude/latitude coordinates to the computer and the computer determines, from the preloaded coordinate information, the longitude and latitude coordinates of the next or approaching tower and the distance to the next tower and to the next still camera exposure point. The computer then calculates the time delay, taking into account the ground speed of the aircraft, until the aircraft arrives at the exposure point where the still cameras are to be operated to capture the image.** While this is taking place, the system is reset to capture the images of the next tower."), 4:23-30 ("In either embodiment, a signal is generated as the aircraft is approaching and flying over a particular tower by either of the mentioned alternatives, with that signal being transmitted to the onboard computer. The onboard computer, based on the ground speed of the aircraft, determines the time necessary for the aircraft to fly from the point of receiving the signal past the detected tower a distance corresponding to the exposure point relative to the tower."), 4:31-34 ("**The data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft where it is stored for later retrieval and post processing as desired.**"), 5:43-54 ("**To that end and in accordance with this invention, a fixed wing aircraft 26 is equipped with a data collection system.** In the preferred embodiment of this invention, the fixed wing aircraft is a Piper Pawnee of the type commonly used in crop dusting applications. The data collection system includes a pod 28 fixed to the underside 31 of the aircraft fuselage generally in the area which would

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Claim 1	Prior Art
	coincide with the center of gravity of the aircraft. Locating the pod in the area of the center of gravity minimizes the error in the data collection system that can occur due to movement of the aircraft from the preferred line of flight, as will be described and/or become evident from the description to follow."), 5:62-6:2 ("The data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures, the equipment supported on the tower structures and the transmission cables themselves, as well as images of the right-of-way. **The number and arrangement of the cameras can vary, but preferably two digital still cameras 34 and 36** and two digital video cameras 38 and 40 **are mounted within the housing.**"), 6:31-58 ("The digital still cameras are supported in the pod by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The cameras look through a short tunnel section 56 of the pod housing. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses. The still cameras are preferably Kodak DCS-560 digital still cameras. These cameras produce digital still images at resolutions of over 2000 by 3000 pixels. These cameras capture images at the rate of 1 image per 4.5 seconds and are used to capture images of the tower structures 10 at their particular locations. **The still cameras write their information to a removable hard drive (conventional and therefore not shown in detail) incorporated and operatively associated with the onboard computer 42 and data storage units 44, but the cameras could write their information directly to the onboard computer via a well known and conventional firewire connection.** To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters to eliminate inconsistent trip delay times.

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	This is preferably preformed ½ second prior to the actual trip. As will be described more completely hereinafter, the actual trip time is calculated either by using a GPS location and known structure locations, or by using a laser altimeter."), 7:13-31 ("**The cameras provide the image-acquiring portion of the overall system. That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer.** The onboard computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."), 7:34-55 ("**In the preferred embodiment, the GPS 76, in its preferred form, is a differential system (DGPS) 78 of the type commercially available and referred to as a SATLOK L-Band differentially corrected GPS unit.** The use of the DGPS enhances the accuracy of the geographical locating ability of the system. As illustrated, this unit operates off of two satellites 79 and 81 and produces sub-meter accuracy. **The data from the GPS is transmitted to the computer via standard NEMA format at 10 Hz frequency, line 83.** The differential signal is received by the omni-star system which means that it receives its correction information from satellites 79 and 81. This allows for continental coverage at all times. This unit is also connected to the daylight readable front mounted display 46 that allows the pilot to view signal quality

Claim 1	Prior Art
	as well as all times without having to look inside the cockpit. **The GPS sends real time corrected latitude/longitude readings to the computer and the computer is then able to perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing.** The GPS unit 76, particularly its antenna, can be supported at a convenient position on the exterior of the aircraft fuselage."), 7:56-58 ("**The trigger system 74 in the preferred embodiment is a laser altimeter, a conventional and commercially available device.**"), 8:15-34 ("The laser altimeter 74 can be supported on the outer housing of the pod or, as shown, at a convenient location on the aircraft fuselage 30 and connected in a conventional manner to the on board computer. That connection is illustrated schematically in FIG. 8 as being through the interface board 77 and directly to the computer, interface 83 and line 85 respectively. As is well known, **the laser altimeter by projecting a laser beam 87 downwardly to the terrain, is capable of determining the height of the aircraft above the terrain**. It can be used to obtain data and artificially reproduce the topography of the terrain 12 along the right-of-way. In the application of this invention, it is used to detect the presence of a tower structure. When the beam 87 is interrupted by a tower structure, the laser altimeter detects the major difference in height of the aircraft above a tower 10 as compared to height of the aircraft above the terrain it had been sensing as the aircraft approached the tower. **The laser altimeter generates a signal in response to that difference which is transmitted to the onboard computer establishing the fact that the aircraft has passed over a tower.**"), 9:6-13 ("**The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude. With the appropriate software programming as mentioned above, the system is capable of embedding the longitude/latitude**

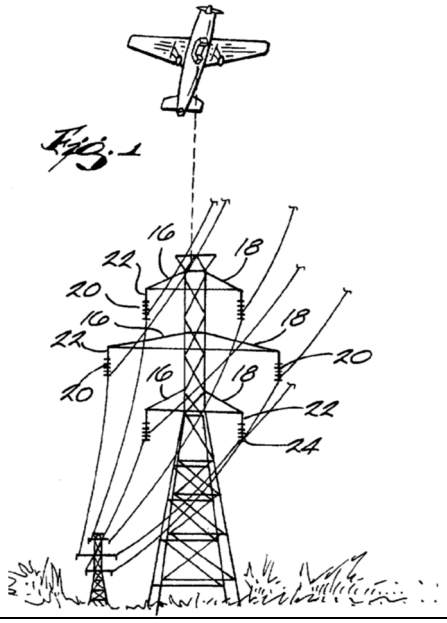
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	coordinates for either the video output or **the still camera output.** That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association with the image of a particular tower."), 9:14-31 ("In the GPS camera trip mode (FIG. 9), **the GPS camera trip software module requires that the computer be given the latitude/longitude location of every tower that is to be filmed. The computer then steadily calculates the distance from a last GPS reading at 95 the last tower encountered to the first tower location to be encountered after that last tower GPS reading. The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., arrive at a particular desired exposure point for the still cameras a predetermined distance past the tower.** The programming allows for varying the preselected distance, and thus the exposure point, as required or desired. The system is reset 101 with the next trip location being loaded into the computer and the camera trip program starts over again. **During the camera trip the computer program records the time and location of the trip into a separate file for post processing of the images**."), 10:4-13 ("More particularly and in accordance with the alternative embodiment of this invention and with reference to FIG. 10, the laser altimeter 74 will detect the passage of the aircraft over a tower structure and generate a signal at that point. **The signal is used to enable the system to embed the longitude/latitude coordinates of that tower location on the corresponding tower image, either the output from** the video or the output from **the still cameras**, or both. This provides a continuous identification of the geographical location of the towers in the power line."), 10:24-43 ("In one embodiment, and assuming the objective is to obtain both an inventory of the tower structures and an inspection of the towers and related equipment of a particular transmission line, an initial fly over is executed to provide

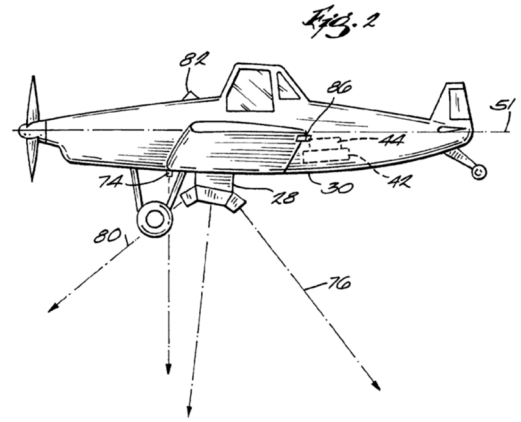
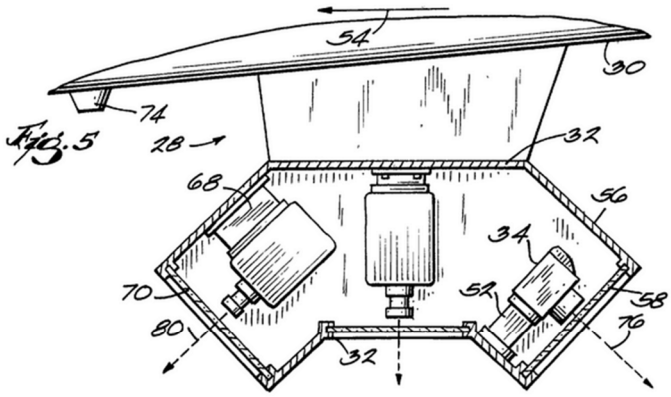
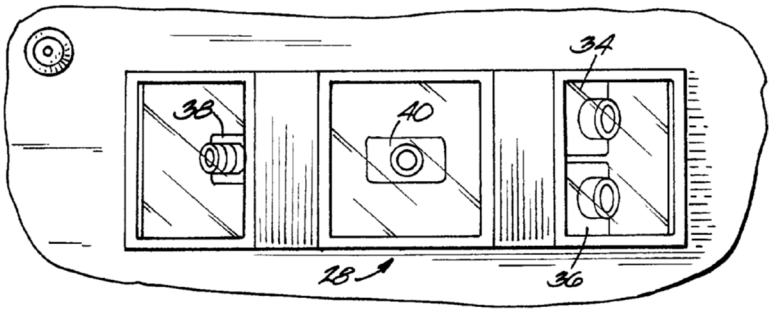
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	basic data on the location of the towers. In that operation, the aircraft flies the transmission line with the video cameras operational. As the aircraft passes over a particular tower structure (sensed by the laser altimeter), **the longitude/latitude coordinates are identified by the GPS and embedded in the imaging database** in association with that particular tower structure. The system is also capable of assigning an inventory number to that tower structure. This is done for the entire transmission line being processed. This initial step would be utilized where the transmission line company does not already have established inventory database of the location of its towers. If the transmission line company has an established inventory database of its tower locations, by longitude/latitude, the initial fly over step is eliminated and the data on tower location is inputted from that database."), 10:50-67 ("In this embodiment, **the inspection system utilizes the inputted geographic coordinates to arm and trigger the still cameras. More particularly, the GPS 76 constantly monitors the location of the aircraft relative to the tower structure geographical database**. When the system detects that it has flown over a particular tower structure, that being accomplished when the detected longitude/latitude coordinates correspond to the inputted database longitude/latitude coordinates 95 (FIG. 9), the computer system is advised that the next tower will be available at a particular upcoming set of longitude/latitude coordinates. The computer then calculates 97 (FIG. 9), based on the ground speed of the aircraft, the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point), measured in feet from the tower at which point the still cameras are activated to record the images 99 (FIG. 9). The system is reset 111 for the next tower to be photographed."), 11:36-40 ("In the preferred embodiment, the digital still cameras can be oriented such that they would both take a landscape type photograph or one would capture a landscape photograph whereas the other camera would produce a portrait photograph."),

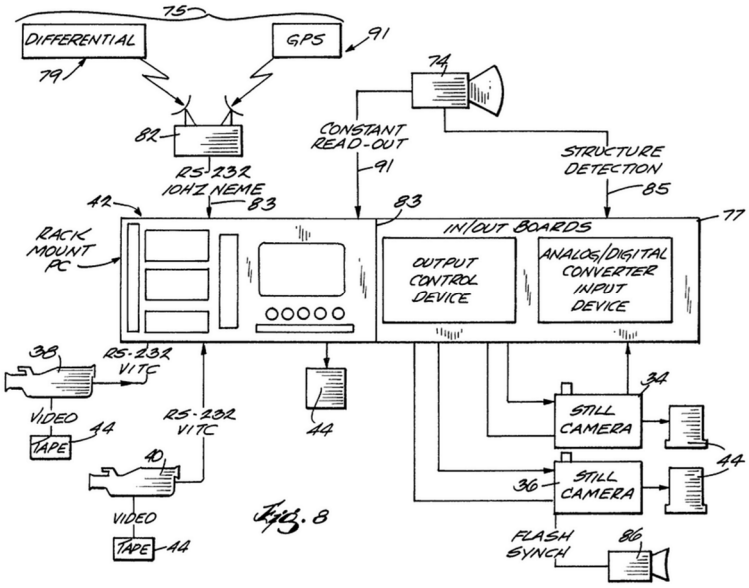
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Claim 1	Prior Art
	Claim 1 ("A **system for acquiring images** of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said system utilizing an aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software and connected to said cameras, said means for detecting a tower structure, and said storage unit, said system comprising the steps of:…."), Claim 4 ("4. The system of claim 2 **including a GPS unit** connected to said central processing unit, said **GPS generating continuous signals of the longitude/latitude coordinates of the position of said aircraft along said transmission line and transmitting said coordinates to said central processing unit and said central processing unit embedding the coordinates for a tower which image has been captured in association with the data for the image** of that tower so that when the image of said tower is retrieved from storage the coordinates of that tower are also reproduced on the image."), Fis.1, Fig.6, Fig.8. 

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	 Fig. 8
[1.a]: a first image-capturing device, said first image-capturing device capturing oblique aerial images[1] at	**Loewen discloses or renders obvious this limitation.** **Loewen discloses a first image-capturing device** (*e.g.*, "still camera" (*e.g.*, Fig. 1("still camera[] 34"))**, said first image-capturing device capturing oblique aerial images** (*e.g.*, conventional "still camera[] point[s] rearwardly relative to the line of flight of the aircraft and take[s] a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees"; "still cameras… arranged to take

[1] As discussed (*see* §V.C), I have been asked to assume that "oblique aerial images" means "an aerial image capturing a generally trapezoidal area or view of the subject surface or object, with the foreground of the trapezoid having a substantially smaller ground sample distance (i.e., a higher resolution) than the background of the trapezoid." The '657 patent provides exemplar oblique aerial images, explaining, *e.g.*, that "[f]or oblique, community-level images, the ground sample distance varies from, for example, approximately one-foot per pixel in the foreground of the image to approximately two-feet per pixel in the mid-ground of the image, and to approximately four-feet per pixel in the background of the image" (*i.e.*, a ground sample distance in the background of the image that is approximately 4 times the ground sample distance in the foreground). EX1001, 13:55-60. The '657 patent also explains that "[o]blique neighborhood-level image

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have a ground sample distance of, for example, from approximately four-inches per pixel in the foreground of the image to approximately six-inches per pixel in the mid-ground of the image, and to approximately ten-inches per pixel in the background of the image" (*i.e.*, a ground sample distance in the background of the image that is approximately 1.67 times the ground sample distance in the foreground). EX1001, 14:4-9. Aerial imagery meeting the '657 patent's definition of "oblique aerial images" and having the above-discussed exemplary background to foreground ground sample distance ratios has long been known, as has the ability to select basic camera parameters such as "field of view," in order to obtain aerial imagery having properties POSITA would have found beneficial for a particular desired use. For example, as of at least 1960, POSITA wishing to increase the ground area covered during an aerial survey would have been well aware of how to select a camera angle and to select a lens to increase the camera's field of view (which is the viewable area that can be imaged by a camera's lens system), which would in turn have increased the ground area covered during a survey. EX1019, 1. In my opinion, POSITA would have understood that oblique imagery (as I understand that term is defined in the '657 patent) would have been useful to, *e.g.*, capture images of the layouts of roads or other structures (such as power transmission towers) or obtain views of larger portions of the right-of-way between power transmission towers as described in Loewen than would have been possible using smaller fields of view at the same camera angle, and that using this larger field of view (yielding an oblique aerial image) would have been beneficial because it would have allowed for the capture of the entire area of interest, *e.g.*, using fewer photographs than would have been the case if a smaller field of view were used. In my opinion, Loewen expressly discloses "oblique aerial images" under the above-discussed construction that I have been asked to assume. Loewen discloses its system as, *e.g.*, solving the problem of "inspect[ing] both the right-of-way for electrical transmission lines and the tower structures and related equipment supporting the transmission lines along the right-of-way," including "to detect problems in the right-of-way and defects in the equipment supported on the towers… and the lines themselves at the tower structure." EX1004, 1:28-53, 5:7-24 ("Electrical power is conveyed over transmission lines between power generating plants, field stations, states and the like. In their most basic configuration, these systems include towers 10, which in major part are uniformly spaced along the terrain 12 a desired distance, for example, two-tenths of a mile apart. Transmission cables or lines 14 are strung between the towers and suspended above the terrain."), 5:33-42 ("It is also required to inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees

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and other plant growth or the like have encroached into the right-of-way"). POSITA wishing to obtain aerial images of, *e.g.*, towers and long stretches of power transmission lines and/or right-of-way for this purpose (*e.g.*, to look for downed wires or other damage following a severe storm, to look for large obstructions in the right-of-way, etc.) as Loewen describes would have readily understood Loewen discloses implementing its system using Loewen's expressly-disclosed parameters along with additional conventional camera parameters well-known to POSITA (such as field of view) to provide such views as Loewen here contemplates. For this purpose disclosed by Loewen, starting with, *e.g.*, Loewen's expressly-preferred 45 degree still camera angle (*e.g.*, EX1004, Abstract, 2:46-49 (expressly disclosing still cameras "at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees"), cl.10), POSITA would have understood Loewen to disclose using a relatively large field of view (*i.e.*, at the higher end of the conventional and well-known range of fields of view) to capture towers and long stretches of power transmission lines and/or an extended view of the right-of-way as Loewen discloses, yielding an oblique aerial image as defined in the '657 patent. For example, implementing Loewen's preferred 45 degree camera angle with a 60 degree field of view (which was conventional and well-known), yields a ground sample distance in the background of the image that is approximately 3.73 times that of the foreground. POSITA would thus have understood Loewen, in describing this camera angle and application, to disclose using a relatively large field of view yielding an oblique aerial image. To the extent it is argued that further disclosure of Loewen's system capturing "oblique aerial images" using one or more of Loewen's image-capturing devices is required, for these same reasons POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed angled still camera using a relatively large field of view (*i.e.*, at the higher end of the conventional and well-known range of fields of view) yielding an oblique aerial image as defined in the '657 patent, to capture towers and long stretches of power transmission lines and/or an extended view of the right-of-way and beneficially achieve the above-discussed objectives. POSITA would have recognized that increasing the field of view would have advantageously permitted the user of Loewen's system to increase the area of ground visible in each of Loewen's captured images, as appropriate to the specific application (*e.g.*, capture of a larger area of ground, where more context for captured images is required). For POSITA, this would have been an obvious, routine implementation choice, and clear this would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* n.11.

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image-capturing events, said first image-capturing device issuing first image-data signals corresponding to captured images;	pictures along a line 76 at an angle to the line of flight… in the range of 30–60 degrees, preferably 45 degrees"; Figs.2-3, 5) **at image-capturing events** (*e.g.*, event in which "still camera is activated at the exposure point to acquire an image"; "still camera" "trigger[ed]… to acquire the images"; "computer… perform[s] real time coordination of camera tripping"; "still cameras" "automatically activate[d]… at the exposure points along the transmission line"; "cameras… trigger[ed] based on actual detection of the presence of the tower structure")**, said first image-capturing device issuing first image-data signals corresponding to captured images;** (*e.g.*, "cameras… write their information directly to the onboard computer"; "data corresponding to the [camera's] acquired image is transmitted to a data storage unit"; "data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft")**.** *See, e.g.*, EX1004, Abstract ("A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. **The system uses a fixed wing aircraft and an arrangement of at least one still camera**, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for

To the extent the construction I have been asked to assume for "oblique aerial images" is not adopted and Patent Owner's broader construction of oblique aerial image as including any image taken in which the image-capturing device is aimed or pointed generally to the side of and downward from the platform that carries the image-capturing device is adopted, in my opinion, "oblique aerial images" is expressly disclosed by the above-discussed Loewen disclosures because Loewen expressly discloses multiple still cameras taking images at an angle, *e.g.*, EX1004 (**Loewen**), 2:46-49, which satisfies this broader construction.

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Claim 1	Prior Art
	comparison to those preset coordinates. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). **The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees.** The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. **The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower.** The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way."), 2:30-38 ("For the achievement of these and other objects, this invention proposes a system utilizing a fixed wing aircraft which is flown in close proximity to the towers to enable **an arrangement of still, digital cameras on the aircraft to capture high resolution images** of the electric transmission line tower structures and equipment attached to those towers. **Although this discussion will refer to the use of plural cameras, it will be appreciated that this invention contemplates the use of one or more still cameras.**"), 2:39-49 ("In accordance with this invention, the still cameras take pictures of the towers from an exposure point between two adjacent towers and along an exposure line that is at a shallow angle to the horizontal. The horizontal is defined in terms of the desired line of flight of the aircraft; the line of

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Claim 1	Prior Art
	flight being generally parallel to the terrain over which the transmission lines are strung and over which the aircraft is flying. **The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees.**"), 3:3-10 ("The still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device. **The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line.**"), 3:11-15 ("In one embodiment, the tower detecting device is in the form of a laser altimeter. In an alternative embodiment, the system also contemplates the use of a GPS capability which cooperates in detecting the presence of a tower structure that is to be photographed."), 4:1-13 ("When the alternative of preloaded longitude/latitude coordinates is used, the **GPS unit is used in the activation of the still cameras.** More particularly, the GPS continuously transmits longitude/latitude coordinates to the computer and the computer determines, from the preloaded coordinate information, the longitude and latitude coordinates of the next or approaching tower and the distance to the next tower and to the next still camera exposure point. **The computer then calculates the time delay, taking into account the ground speed of the aircraft, until the aircraft arrives at the exposure point where the still cameras are to be operated to capture the image**. While this is taking place, the system is reset to capture the images of the next tower."), 4:31-34 ("**The data generated by the still cameras is transmitted, in digital form, to a data storage system on**

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Claim 1	Prior Art
	board the aircraft where it is stored for later retrieval and post processing as desired."), 5:62-6:2 ("**The data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures, the equipment supported on the tower structures and the transmission cables themselves, as well as images of the right-of-way.** The **number and arrangement of the cameras can vary**, but preferably two digital still cameras 34 and 36 and two digital video cameras 38 and 40 are mounted within the housing."), 6:31-58 ("**The digital still cameras are supported in the pod by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft.** Arrow 54 in FIG. 5 illustrates the direction of flight. The cameras look through a short tunnel section 56 of the pod housing. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses. The still cameras are preferably Kodak DCS-560 digital still cameras. **These cameras produce digital still images at resolutions of over 2000 by 3000 pixels. These cameras capture images at the rate of 1 image per 4.5 seconds and are used to capture images of the tower structures 10 at their particular locations. The still cameras write their information to a removable hard drive (conventional and therefore not shown in detail) incorporated and operatively associated with the onboard computer 42 and data storage units 44, but the cameras could write their information directly to the onboard computer via a well known and conventional firewire connection.** To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters to eliminate inconsistent trip delay times. This is preferably preformed ½ second prior to the actual trip. As will be described more completely hereinafter, the actual trip time

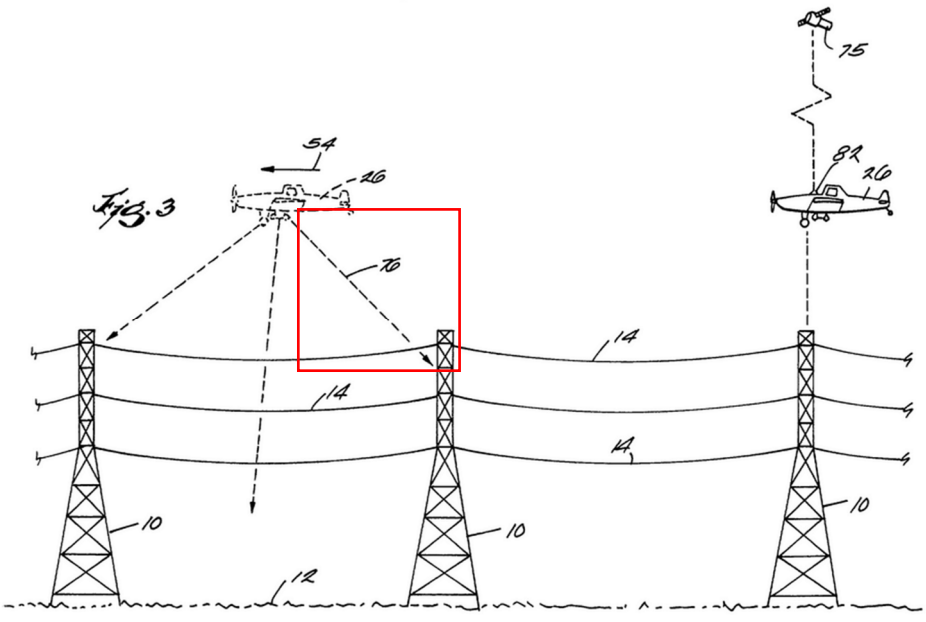
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Claim 1	Prior Art
	is calculated either by using a GPS location and known structure locations, or by using a laser altimeter."), 7:13-31 ("**The cameras provide the image-acquiring portion of the overall system. That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer.** The onboard computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."), 7:49-54 ("The **GPS sends real time corrected latitude/longitude readings to the computer and the computer is then able to perform real time coordination of camera tripping** and latitude/longitude signals for inventory or survey processing.") 7:62-8:7 ("Using the line of flight of the aircraft 54 as a base of reference, a reference base which corresponds generally with the longitudinal axis of the aircraft, **the still cameras are arranged to take pictures along a line 76 at an angle to the line of flight. That angle is in the range of 30–60 degrees, preferably 45 degrees.** Since the aircraft will make its fly over in a horizontal flight altitude, this direction or line of flight will be referred to as horizontal and the angle of the camera orientation will be referred to as being at an angle to the horizontal. It being noted, in that altitude the axis 51 of the

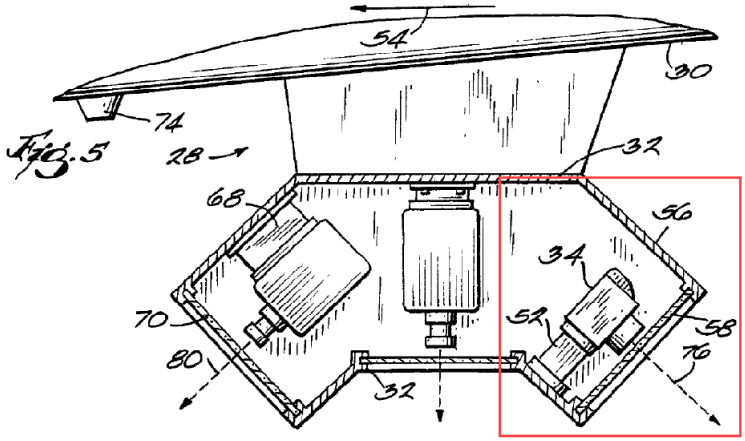
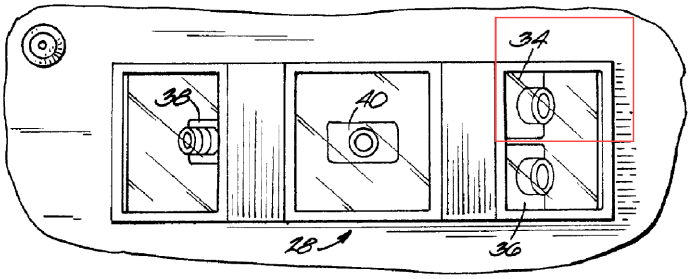
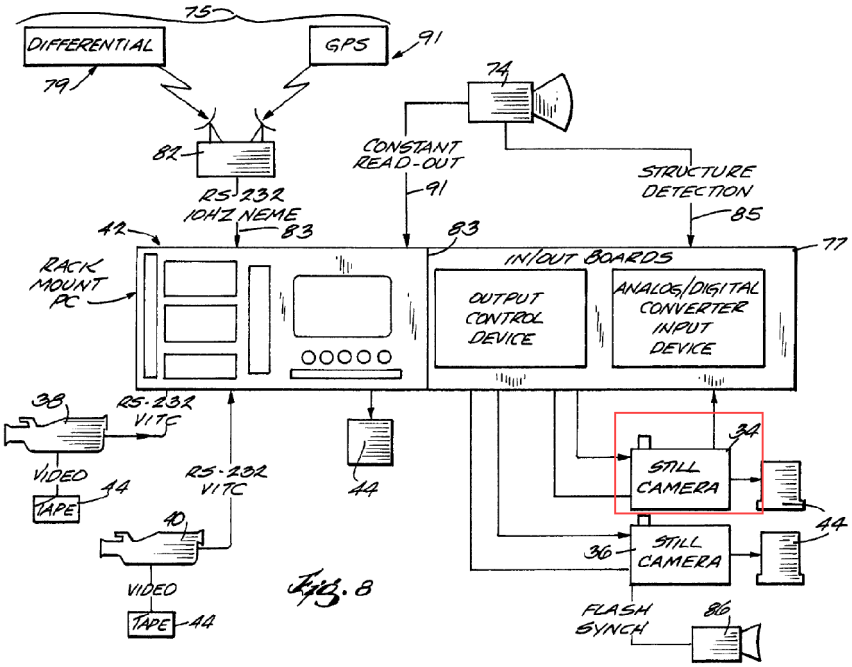
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Claim 1	Prior Art
	aircraft is normally horizontal and the camera exposure angles could also be described in reference to the longitudinal axis of the aircraft."), 10:50-67 ("In this embodiment, **the inspection system utilizes the inputted geographic coordinates to arm and trigger the still cameras**. More particularly, the **GPS 76 constantly monitors the location of the aircraft** relative to the tower structure geographical database. When the system detects that it has flown over a particular tower structure, that being accomplished when the detected longitude/latitude coordinates correspond to the inputted database longitude/latitude coordinates 95 (FIG. 9), the computer system is advised that the next tower will be available at a particular upcoming set of longitude/latitude coordinates. The computer then calculates 97 (FIG. 9), based on the ground speed of the aircraft, the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point), measured in feet from the tower at which point **the still cameras are activated to record the images** 99 (FIG. 9). The system is reset 111 for the next tower to be photographed."), 11:1-14 ("In another embodiment, the physical detection of the presence of the tower structure is sensed and the system is enabled on that basis 105 (FIG. 10). That is, the laser altimeter is continually sensing the profile of the terrain with its downwardly directed beam. **As the aircraft passes over the tower structure it detects a major difference in distance from the aircraft to the top of the tower structure as compared to the distance from the aircraft to the terrain. That signal is transmitted to the computer system which then accomplishes a calculation 107 (FIG. 10) based on ground speed to enable and trigger the camera shutters 109 (FIG. 10) at a preselected distance past the tower structure**. The system is reset 111 for the next tower to be photographed."), 11:15-18 ("The second embodiment wherein **the cameras are enabled to trigger based on actual detection of the presence**

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Claim 1	Prior Art
	of the tower structure is preferred as it is more consistent and reliable in operation."), 11:41-51 ("**The exposure point for the still cameras is illustrated by the dotted line showing of the aircraft in FIG. 3. The exposure point is horizontally between two adjacent towers 10 and the still cameras are photographing the trailing tower, i.e., trailing relative to direction of flight of the aircraft. The still photographs are taken along a line which is 30–60 degrees to the horizontal, preferably 45 degrees.** Those parameters of location of the exposure point and the line of camera exposure place the cameras in close proximity to the tower being photographed to achieve high-resolution imagery for later defection investigation."), Fig.3, Figs.5-6, Figs.8-10. 

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Claim 1	Prior Art
	 Fig. 5  Fig. 6  Fig. 8

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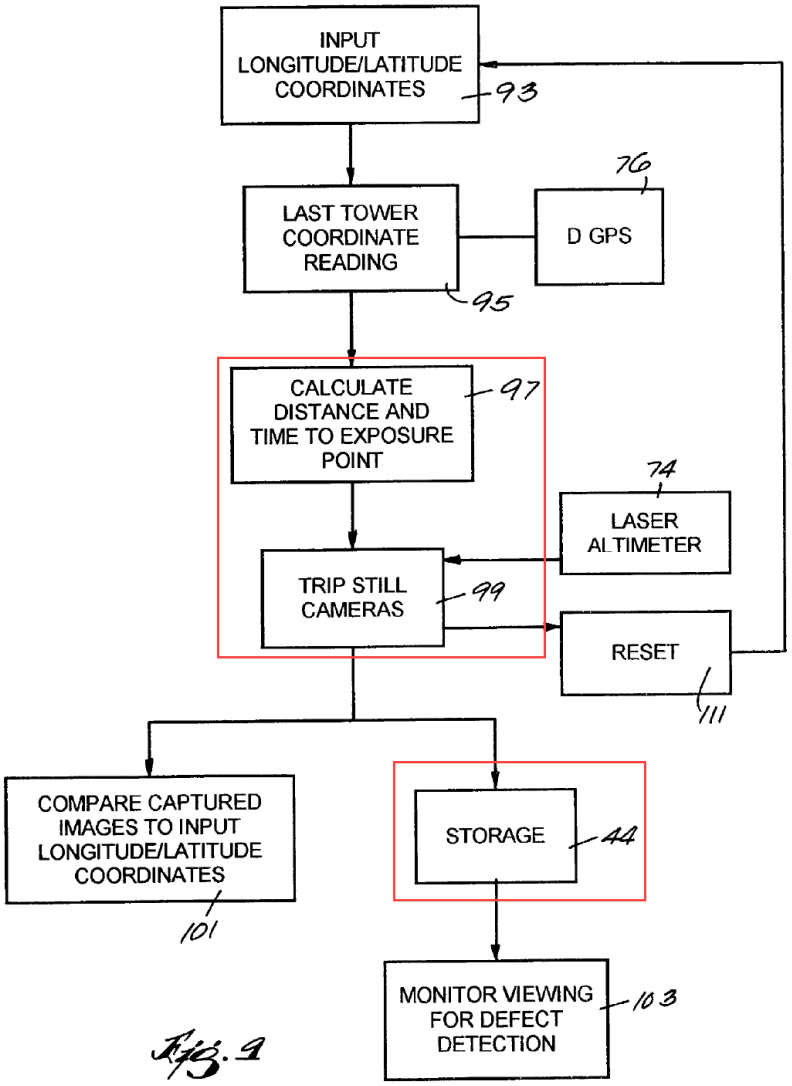
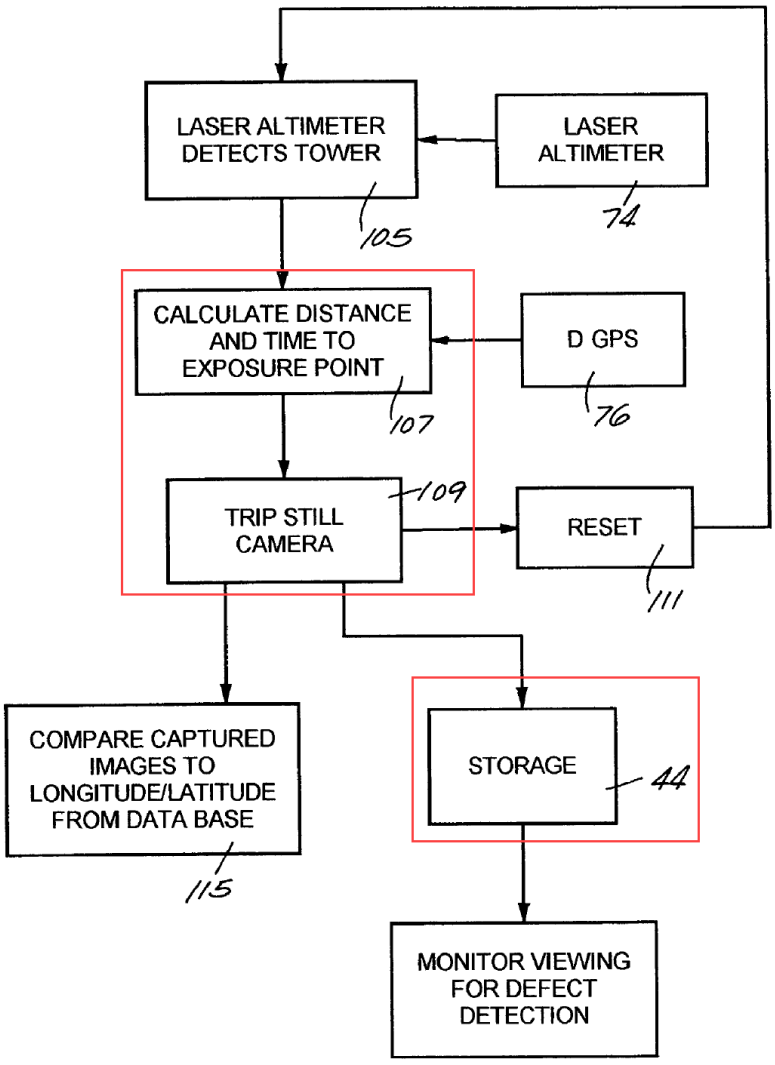
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Fig. 9

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Claim 1	Prior Art
	 Fig. 10
[1.b]: a second image-capturing device, said second image-capturing device capturing images at	**Loewen discloses this limitation.** **Loewen discloses a second image-capturing device** (*e.g.*, second "still camera[]" (*e.g.*, Fig.6 ("still camera[] 36")); any additional still camera (*e.g.*, "more still cameras"))**, said second image-capturing device capturing images at image-capturing events** (*see* cl.1.a)**, said second image capturing**

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Claim 1	Prior Art
image-capturing events, said second image capturing device issuing second image-data signals corresponding to captured images;	**device issuing second image-data signals corresponding to captured images** (*see* cl.1.a)[2]**.** *See, e.g.*, EX1004, Abstract ("A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). **The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees.** The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify

[2] Loewen expressly discloses, *e.g.*, that each camera issues image-data signals corresponding to images captured by that camera. *E.g.*, EX1004, 4:31-34 ("data generated by the still ***cameras*** is transmitted, in digital form, to a data storage system on board the aircraft"), 6:31-58 ("***cameras***… write their information directly to the onboard computer").

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Claim 1	Prior Art
	defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way."),[3] 2:30-38 ("For the achievement of these and other objects, this invention proposes a system utilizing a fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images of the electric transmission line tower structures and equipment attached to those towers. **Although this discussion will refer to the use of plural cameras, it will be appreciated that this invention contemplates the use of one or more still cameras.**"),[4] 2:39-49 ("In accordance with this invention, **the still cameras take pictures of the towers from an exposure point between two adjacent towers and along an exposure line that is at a shallow angle to the horizontal.** The horizontal is defined in terms of the desired line of flight of the aircraft; the line of flight being generally parallel to the terrain over which the

[3] While claim 1 does not require that the second image-capturing device capture oblique aerial images, the I identify detailed disclosures here concerning Loewen's disclosure of a second still camera that captures oblique aerial images as pertinent not only to the broader requirements of claim 1, but also as to coverage of narrower later limitations, including, *e.g.*, cl.4, cl.20, cl.21, and cl.26.

[4] POSITA would have understood Loewen's reference to "one or more still cameras" (EX1004, 2:36-38)—instead of "one or two still cameras"—to be an explicit disclosure of at least three still cameras. In the alternative, POSITA would at minimum have found it obvious to implement Loewen's teachings using three still cameras (instead of, e.g., two still cameras and a video camera), and in light of Loewen's express disclosures (e.g., of "one or more still cameras (e.g., EX1004, 2:36-38)). The Grounds herein rely on Loewen's disclosure of three still cameras for claims 20, 21, 26, and 27. *See* cl.20, cl.21, cl.26, cl.27. As discussed immediately above, Loewen discloses or at minimum renders obvious three still cameras.

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Claim 1	Prior Art
	transmission lines are strung and over which the aircraft is flying. The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees."), 3:3-10 ("The still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device. **The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line.**"), 4:1-13 ("When the alternative of preloaded longitude/latitude coordinates is used, the **GPS unit is used in the activation of the still cameras.** More particularly, the GPS continuously transmits longitude/latitude coordinates to the computer and the computer determines, from the preloaded coordinate information, the longitude and latitude coordinates of the next or approaching tower and the distance to the next tower and to the next still camera exposure point. **The computer then calculates the time delay, taking into account the ground speed of the aircraft, until the aircraft arrives at the exposure point where the still cameras are to be operated to capture the image**. While this is taking place, the system is reset to capture the images of the next tower."), 4:31-34 ("**The data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft where it is stored for later retrieval and post processing as desired.**"), 5:62-6:2 ("The data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures, the equipment supported on the tower structures and the transmission cables themselves, as well as images of the right-of-way. **The**

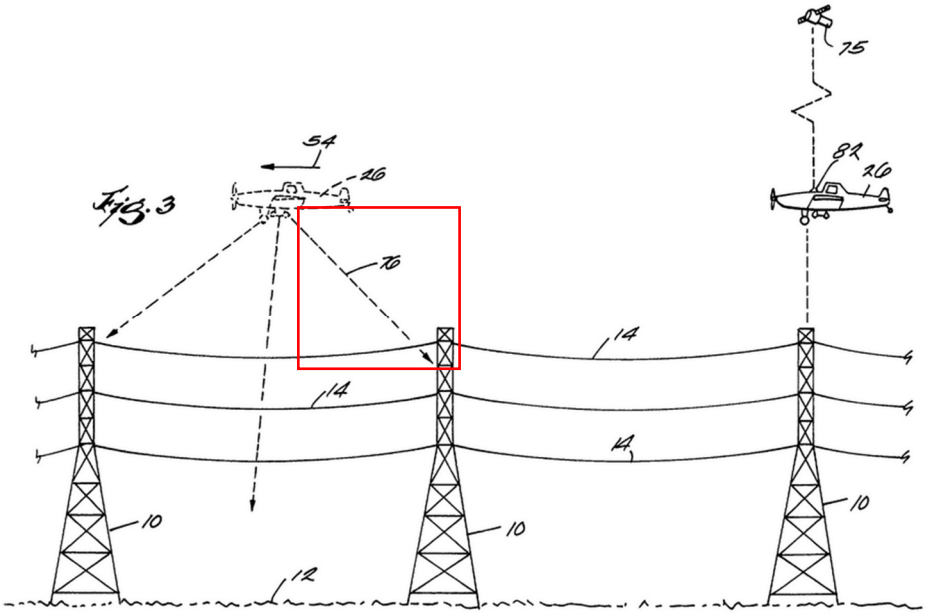
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Claim 1	Prior Art
	number and arrangement of the cameras can vary, but preferably two digital still cameras 34 and 36 and two digital video cameras 38 and 40 **are mounted within the housing.**"), 6:31-58 ("The digital still cameras are supported in the pod by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The cameras look through a short tunnel section 56 of the pod housing. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses. The still cameras are preferably Kodak DCS-560 digital still cameras. These cameras produce digital still images at resolutions of over 2000 by 3000 pixels. **These cameras capture images at the rate of 1 image per 4.5 seconds and are used to capture images of the tower structures 10 at their particular locations. The still cameras write their information to a removable hard drive (conventional and therefore not shown in detail) incorporated and operatively associated with the onboard computer 42 and data storage units 44, but the cameras could write their information directly to the onboard computer via a well known and conventional firewire connection.** To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters to eliminate inconsistent trip delay times. This is preferably preformed ½ second prior to the actual trip. As will be described more completely hereinafter, the actual trip time is calculated either by using a GPS location and known structure locations, or by using a laser altimeter."), 7:13-31 ("**The cameras provide the image-acquiring portion of the overall system. That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the**

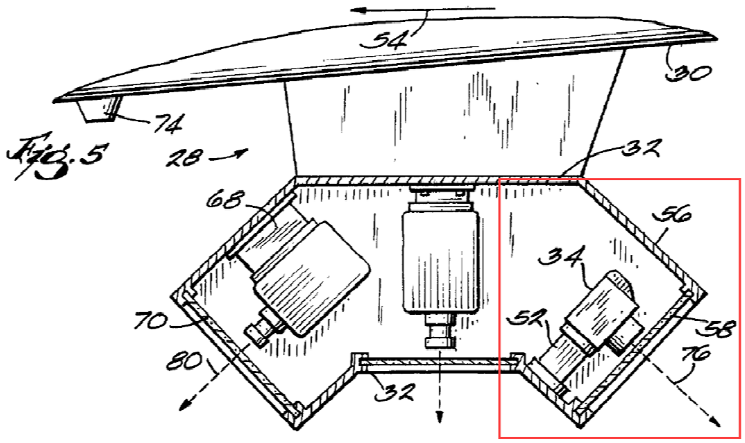
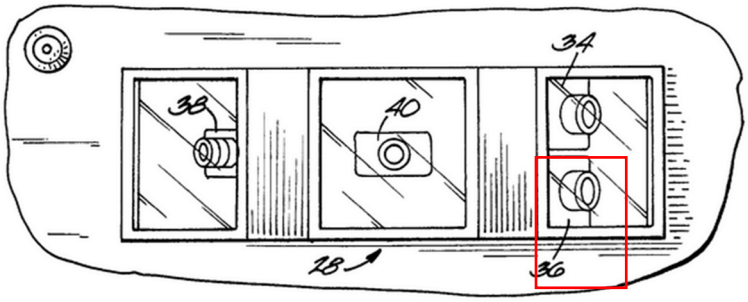
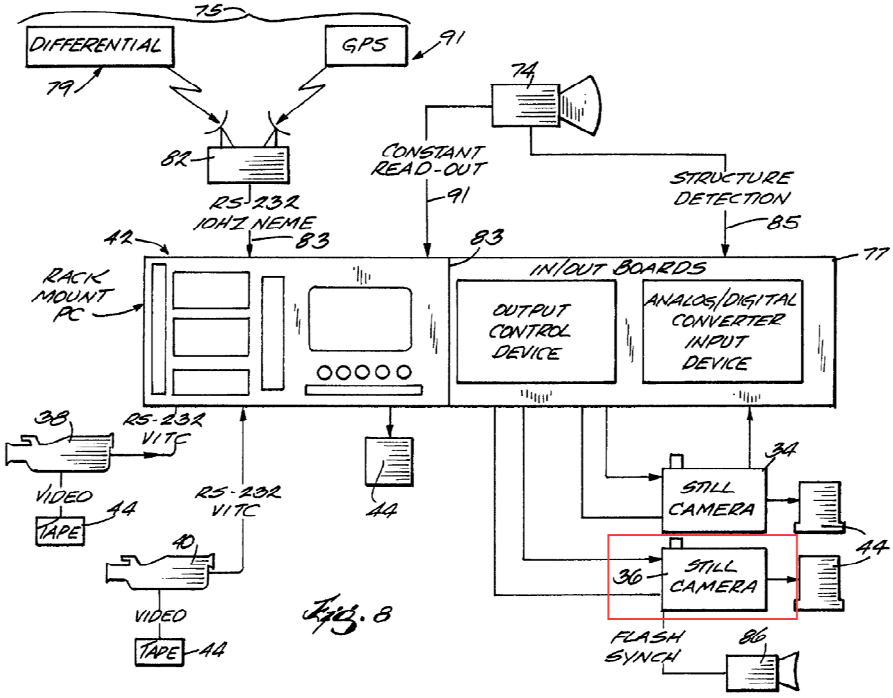
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Claim 1	Prior Art
	GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer. The onboard computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."), 10:50-67 ("In this embodiment, **the inspection system utilizes the inputted geographic coordinates to arm and trigger the still cameras.** More particularly, the **GPS 76 constantly monitors the location of the aircraft** relative to the tower structure geographical database. When the system detects that it has flown over a particular tower structure, that being accomplished when the detected longitude/latitude coordinates correspond to the inputted database longitude/latitude coordinates 95 (FIG. 9), the computer system is advised that the next tower will be available at a particular upcoming set of longitude/latitude coordinates. The computer then calculates 97 (FIG. 9), based on the ground speed of the aircraft, the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point), measured in feet from the tower at which point the still cameras are activated to record the images 99 (FIG. 9). The system is reset 111 for the next tower to be photographed."), 11:1-14 ("In another embodiment, the physical detection of the presence of the tower structure is sensed and the system is enabled on that basis 105 (FIG. 10). That is, the laser altimeter is continually sensing the profile of the terrain with its downwardly directed beam. **As the aircraft passes over the tower structure it detects a major difference in distance from the aircraft to the top of the tower structure as**

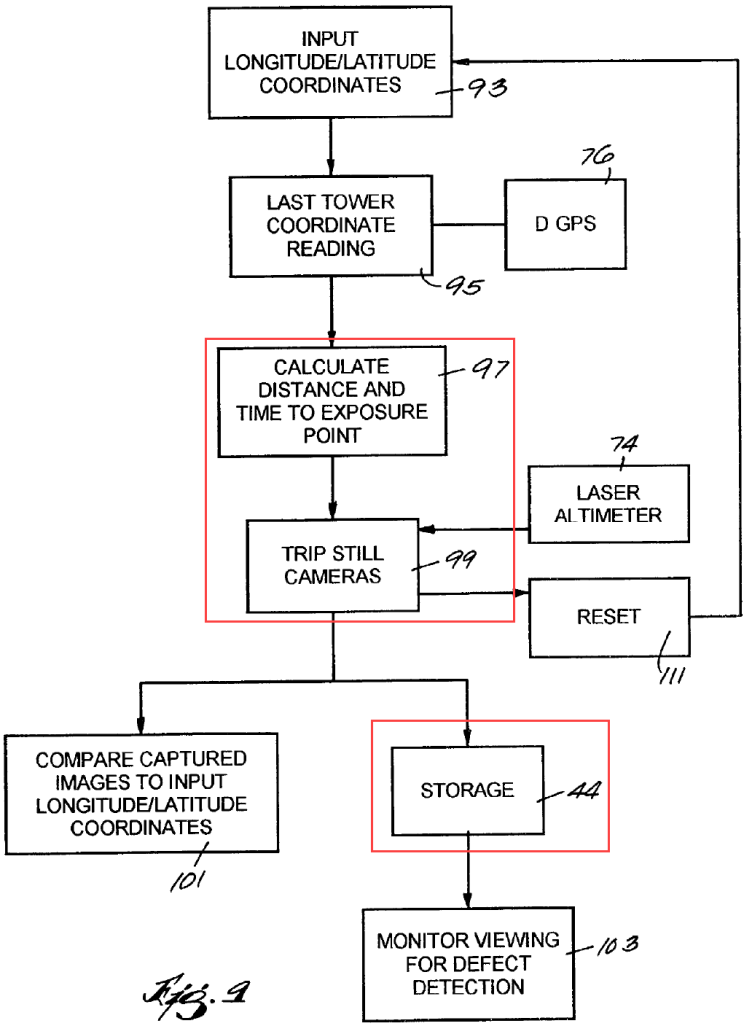
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	compared to the distance from the aircraft to the terrain. That signal is transmitted to the computer system which then accomplishes a calculation 107 (FIG. 10) based on ground speed to enable and trigger the camera shutters 109 (FIG. 10) at a preselected distance past the tower structure. The system is reset 111 for the next tower to be photographed."), 11:15-18 ("The second embodiment wherein the cameras are enabled to trigger based on actual detection of the presence of the tower structure is preferred as it is more consistent and reliable in operation."), Figs.3, 5-6, 8-10. 

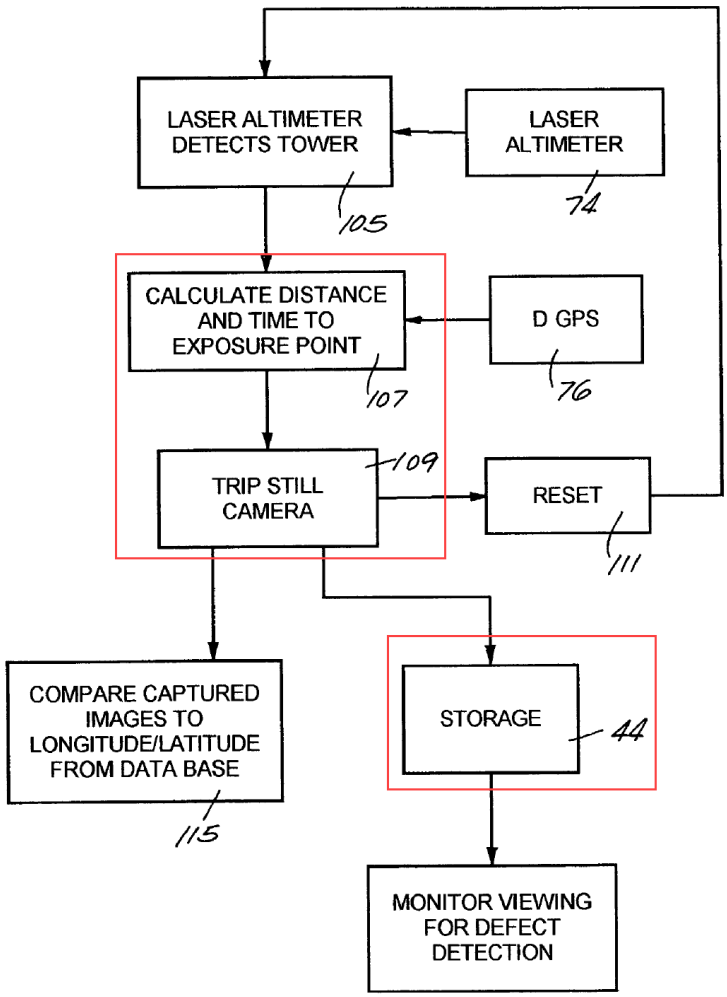
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Claim 1	Prior Art
	 Fig. 5  Fig. 6  Fig. 8

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Claim 1	Prior Art
	 Fig. 9

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Claim 1	Prior Art
	 Fig. 10
[1.c]: at least one geo-locating device, each said at least one geo-locating device issuing a corresponding at least one geo-locating signal, each said at least one geo-	**Loewen discloses this limitation.** **Loewen discloses at least one geo-locating device** (*e.g.*, "GPS," "laser altimeter")**, each said at least one geo-locating device issuing a corresponding at least one geo-locating signal** (*e.g.*, "GPS, in combination with the onboard computer, continuously provides [signal including] the position of the aircraft in longitude and latitude coordinates… transmitted to the onboard computer"; "signal is generated by the laser altimeter" containing "continuous laser readings"; "input from the laser altimeter"; "continuous signal [from laser altimeter] back to the computer")**, each said at least one geo-locating**

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Claim 1	Prior Art
locating signal being indicative at least in part of a geo-location of said first image-capturing device during each first image capturing event;	**signal being indicative[5] at least in part of a geo-location of said first image-capturing device during each first image capturing event** (*e.g.*, "GPS… continuously provides the position of the aircraft in longitude and latitude coordinates… [and] is embedded in the collected data in association with the image… recording… longitude/latitude coordinates in association with the image"; "data" signal from "laser altimeter" indicating "height of the aircraft" and "topography of the terrain… along the right-of-way," "distance in feet above the terrain"; *see* cl.1.a)**.** *See, e.g.*, EX1004, Abstract ("A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means

[5] POSITA would have understood Loewen discloses geolocating devices (GPS and laser altimeter) each issuing a signal indicative at least in part of both a geolocation ***of the first image-capturing device*** (including the first camera (EX1004, Abstract ("a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location"), 3:37-50 ("The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates….")) during the first image-capturing event ***and*** of a geolocation ***of the subject of the photograph*** (including, *e.g.*, a photographed tower structure (EX1004, 8:65-9:5, 9:14-31 ("The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., **arrive at a particular desired exposure point for the still cameras a predetermined distance past the tower**. The programming allows for varying the preselected distance, and thus the exposure point, as required or desired.") 9:65-10:3 ("laser altimeter beam… provides a continuous signal back to the computer of the distance in feet [above] the terrain") during the first image-capturing event")) during the first image-capturing event. As Loewen expressly discloses, the geolocation of the subject of the photograph, such as a tower structure or terrain, has a fixed, known relationship to the geolocation of the camera when this image is captured.

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	for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and **a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates**. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees. The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way."), 3:11-15 ("In one embodiment, the tower detecting device is in the form of a laser altimeter. In an alternative embodiment, **the system also contemplates the use of a GPS capability which cooperates in detecting the presence of a tower structure that is to be photographed**."), 3:37-50 ("**The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates. In accordance with this system, that data is transmitted to the onboard computer and, in accordance with another aspect**

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	of this system, is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower. This recording of the tower location in longitude/latitude coordinates in association with the image of each tower provides an inventory database of all of the towers along a particular transmission line. The embedding of geographical location can be done in association with images captured by both the still and video cameras."), 3:51-57 ("**The still and video images, along with the geographic coordinates are transmitted to data storage units on board the aircraft for post processing or other future use as desired.** For example, post processing can be visual inspection, tower by tower, on a suitable monitor for detection of structural defects."), 4:1-13 ("When the alternative of preloaded longitude/latitude coordinates is used, the GPS unit is used in the activation of the still cameras. More particularly, **the GPS continuously transmits longitude/latitude coordinates to the computer and the computer determines, from the preloaded coordinate information, the longitude and latitude coordinates of the next or approaching tower and the distance to the next tower and to the next still camera exposure point**. The computer then calculates the time delay, taking into account the ground speed of the aircraft, until the aircraft arrives at the exposure point where the still cameras are to be operated to capture the image. While this is taking place, the system is reset to capture the images of the next tower."), 4:14-22 ("In the embodiment which incorporates a laser altimeter, **a signal is generated by the laser altimeter when it detects the presence of a tower**. That **signal is transmitted to the computer** and the computer goes through the same type of calculation as described above to activate the still cameras at the exposure point and to reset the system for the next tower. In this embodiment the computer determines the distance from

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	the detected tower, which is the one to be photo graphed, to the exposure point for that tower."), 7:13-31 ("The cameras provide the image-acquiring portion of the overall system. **That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer.** The onboard computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."), 7:34-55 ("In the preferred embodiment, **the GPS 76, in its preferred form, is a differential system (DGPS) 78 of the type commercially available and referred to as a SATLOK L-Band differentially corrected GPS unit. The use of the DGPS enhances the accuracy of the geographical locating ability of the system.** As illustrated, this unit operates off of two satellites 79 and 81 and produces sub-meter accuracy. **The data from the GPS is transmitted to the computer via standard NEMA format at 10 Hz frequency, line 83.** The differential signal is received by the omni-star system which means that it receives its correction information from satellites 79 and 81. This allows for continental coverage at all times. This unit is also connected to the daylight readable front mounted display 46 that allows the pilot to view signal quality as well as all times without having to look inside the cockpit. **The GPS sends real time corrected latitude/longitude**

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	readings to the computer and the computer is then able to perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing. The GPS unit 76, particularly its antenna, can be supported at a convenient position on the exterior of the aircraft fuselage."), 8:15-34 ("The laser altimeter 74 can be supported on the outer housing of the pod or, as shown, at a convenient location on the aircraft fuselage 30 and connected in a conventional manner to the on board computer. That connection is illustrated schematically in FIG. 8 as being through the interface board 77 and directly to the computer, interface 83 and line 85 respectively. As is well known, **the laser altimeter by projecting a laser beam 87 downwardly to the terrain, is capable of determining the height of the aircraft above the terrain**. It can be used to obtain data and artificially reproduce the topography of the terrain 12 along the right-of-way. In the application of this invention, it is used to detect the presence of a tower structure. When the beam 87 is interrupted by a tower structure, the laser altimeter detects the major difference in height of the aircraft above a tower 10 as compared to height of the aircraft above the terrain it had been sensing as the aircraft approached the tower. **The laser altimeter generates a signal in response to that difference which is transmitted to the onboard computer establishing the fact that the aircraft has passed over a tower.**"), 8:65-9:5 ("**A laser survey module (i.e., terrain mapping) has the computer recording all the GPS data strings as well as continuous laser readings 91 into a text file. This file also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower the same as was described above in connection with the video survey module.**"), 9:6-13 ("**The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude.** With the

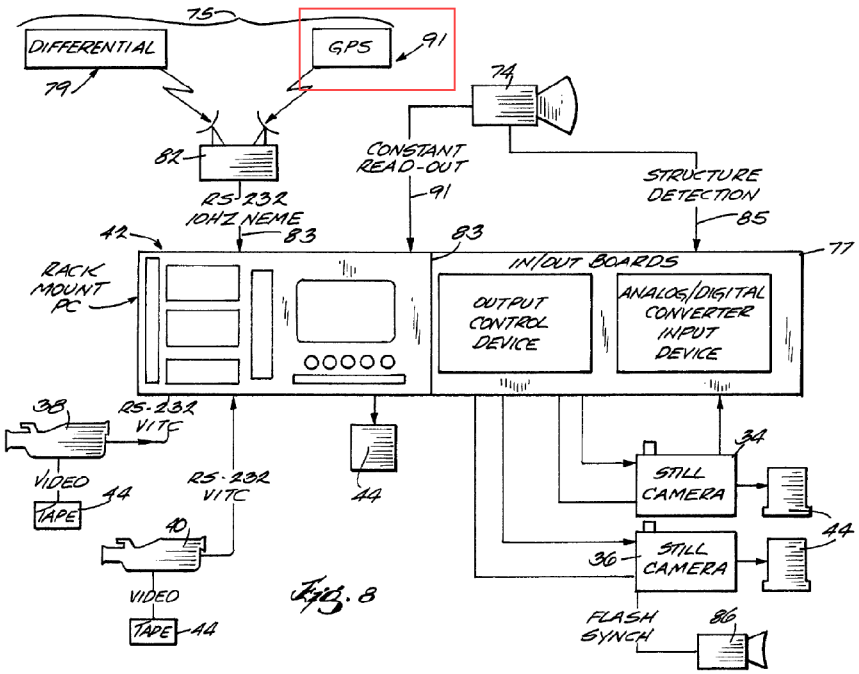
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	appropriate software programming as mentioned above, **the system is capable of embedding the longitude/latitude coordinates for** either the video output or **the still camera output. That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association with the image of a particular tower**."), 9:14-31 ("In the GPS camera trip mode (FIG. 9), the GPS camera trip software module requires that the computer be given the latitude/longitude location of every tower that is to be filmed. **The computer then steadily calculates the distance from a last GPS reading at 95 the last tower encountered to the first tower location to be encountered after that last tower GPS reading.** The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., arrive at a particular desired **exposure point for the still cameras a predetermined distance past the tower. The programming allows for varying the preselected distance, and thus the exposure point, as required or desired**. The system is reset 101 with the next trip location being loaded into the computer and the camera trip program starts over again. During the camera trip the computer program records the time and location of the trip into a separate file for post processing of the images."), 9:32-39 ("The laser altimeter trip software module has the computer responding to the input from the laser altimeter signifying the laser altimeter has identified a tower structure. The program then calculates, using the ground speed, to apply the proper time delay to trigger the still cameras at the desired exposure point. Again **the program records the time of the trip along with the geographic longitude/latitude coordinates of that tower location**."), 9:65-10:3 ("**The laser altimeter beam 87 is directed downwardly, preferably at a right angle to the horizontal, and provides a continuous signal back to the computer of**

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	the distance in feet [above] the terrain. This way, it is also possible to chart the topography of the terrain utilizing the data generated by the laser altimeter."), 10:24-43 ("In one embodiment, and assuming the objective is to obtain both an inventory of the tower structures and an inspection of the towers and related equipment of a particular transmission line, an initial fly over is executed to provide basic data on the location of the towers. In that operation, the aircraft flies the transmission line with the video cameras operational. As the aircraft passes over a particular tower structure (sensed by the laser altimeter), **the longitude/latitude coordinates are identified by the GPS and embedded in the imaging database in association with that particular tower structure**. The system is also capable of assigning an inventory number to that tower structure. This is done for the entire transmission line being processed. This initial step would be utilized where the transmission line company does not already have established inventory database of the location of its towers. If the transmission line company has an established inventory database of its tower locations, by longitude/latitude, the initial fly over step is eliminated and the data on tower location is inputted from that database."), 10:50-67 ("In this embodiment, the inspection system utilizes the inputted geographic coordinates to arm and trigger the still cameras. More particularly, **the GPS 76 constantly monitors the location of the aircraft relative to the tower structure geographical database**. **When the system detects that it has flown over a particular tower structure, that being accomplished when the detected longitude/latitude coordinates correspond to the inputted database longitude/latitude coordinates 95 (FIG. 9), the computer system is advised that the next tower will be available at a particular upcoming set of longitude/latitude coordinates.** The computer then calculates 97 (FIG. 9), based on the ground speed of the aircraft, the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point), measured in feet from the tower at

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	which point the still cameras are activated to record the images 99 (FIG. 9). The system is reset 111 for the next tower to be photographed."), Fig.8. 
[1.d]: a computer system receiving and storing said first and second	**Loewen discloses this limitation.** **Loewen discloses a computer system** (*e.g.*, "onboard computer (a central processing unit) containing operational software"; "onboard aircraft computer 42" (Fig.8); "central processing unit containing operational software")[6] **receiving**

[6] Loewen expressly discloses its "cameras… writ[ing] their information directly to the onboard computer" (*e.g.*, EX1004 6:49-51), and thus that its onboard computer receives and stores the image-data signals from Loewen's image capturing devices. Loewen further discloses, alternatively, that such data can be stored on "data storage units 44," *e.g.*, "in the form of CDs and/or removable hard drives" (*e.g.*, EX1004, 7:59-61) that are "incorporated and operatively associated with the onboard computer." *E.g.*, EX1004, 6:45-49. Such "data storage units" (*e.g.*, "CDs and/or removable hard drives... interconnected with the onboard computer") are

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image-data signals and said at least one geo-locating signal;	**and storing said first and second image-data signals and said at least one geo-locating signal** (*e.g.*, "still and video images, along with the geographic coordinates are transmitted to data storage units on board the aircraft"; "computer recording all the GPS data strings as well as continuous laser readings [] into a text file… file also contains… time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower"; "position of the aircraft in longitude and latitude coordinates" is "transmitted to the onboard computer"; "cameras… write their information directly to the onboard computer"; "onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit"; Fig.8 ("onboard aircraft computer 42")). *See, e.g.*, EX1004, Abstract ("A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees. The detecting means transmits a

thus not separate computer systems, but are part of ("incorporated and operatively associated with") the same "onboard computer" system that runs software executing each of Loewen's system's functions.

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	signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. **The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower.** The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way."), 1:16-24 ("This invention relates to an airborne inventory and inspection system designed **to obtain high resolution images** of electric transmission power lines, the power line right-of-way and the support structure towers, **along with a record of the respective location of the power line towers**, which system is an improvement over current accepted systems and can be performed at a cost that makes use of this system more cost effective than alternatives available to the electrical power transmission industry."), 2:50-3:2 ("More specifically, the aircraft is flown along the transmission line at a low altitude, preferably 60–100 feet above the tops of the tower structures. The aircraft speed is in the range of 80–100 miles per hour. That altitude and speed allow the use of advantageous exposure parameters (shutter speed, lens opening and resulting depth of field) for the cameras such as to result in capturing the high quality, still, high resolution images. **Also, at that speed, sufficient time is available for the transfer of imaging data from the cameras to storage and for resetting the cameras to capture images of the next, upcoming tower.** Placing the exposure point for the still cameras between the adjacent towers and at the shallow angle to the horizontal produces high-resolution

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	images; flying at the above-described altitude contributes to the high-resolution imagery. The exposure point, angle of the line on which the still cameras take the pictures, and the altitude of the aircraft are all factors in insuring that images of at least the upper portion of the tower carrying the transmission lines, the electric insulators, and hardware are properly framed in the picture."), 3:3-10 ("**The still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device**. The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line."), 3:37-50 ("The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates. **In accordance with this system, that data is transmitted to the onboard computer and, in accordance with another aspect of this system, is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower. This recording of the tower location in longitude/latitude coordinates in association with the image of each tower provides an inventory database of all of the towers along a particular transmission line.** The embedding of geographical location can be done in association with images captured by both the still and video cameras."), 3:51-57 ("**The still and video images, along with the geographic coordinates are transmitted to data storage units on board the aircraft for post processing or other future use as desired. For example, post processing can be visual inspection, tower by tower, on a suitable monitor for detection of structural defects.**"),

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	4:31-34 ("**The data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft** where it is stored for later retrieval and post processing as desired."), 6:31-58 ("The digital still cameras are supported in the pod by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The cameras look through a short tunnel section 56 of the pod housing. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses. The still cameras are preferably Kodak DCS-560 digital still cameras. These cameras produce digital still images at resolutions of over 2000 by 3000 pixels. These cameras capture images at the rate of 1 image per 4.5 seconds and are used to capture images of the tower structures 10 at their particular locations. **The still cameras write their information to a removable hard drive (conventional and therefore not shown in detail) incorporated and operatively associated with the onboard computer 42 and data storage units 44, but the cameras could write their information directly to the onboard computer via a well known and conventional firewire connection.** To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters to eliminate inconsistent trip delay times. This is preferably preformed ½ second prior to the actual trip. As will be described more completely hereinafter, the actual trip time is calculated either by using a GPS location and known structure locations, or by using a laser altimeter."), 7:13-31 ("**The cameras provide the image-acquiring portion of the overall system. That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44**

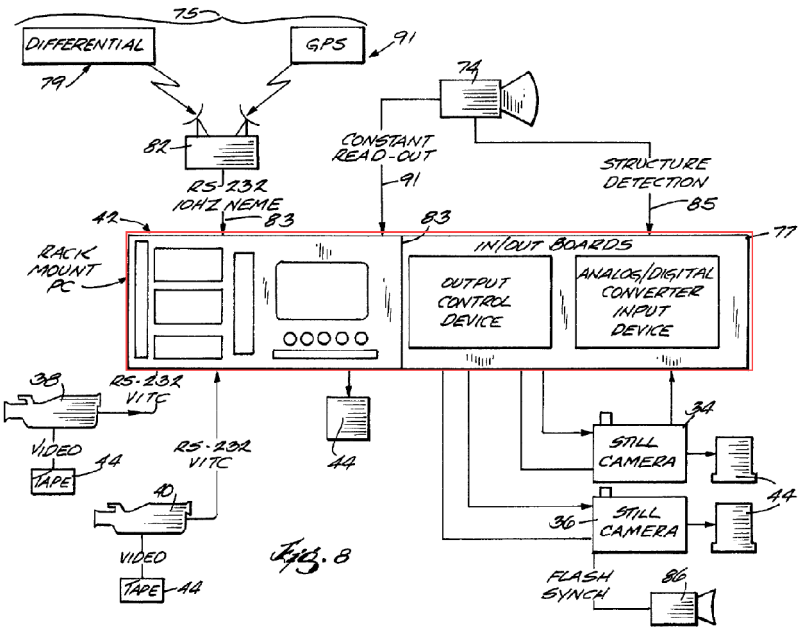
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Claim 1	Prior Art
	which is also interconnected with the onboard computer. The onboard computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."), 7:34-55 ("In the preferred embodiment, the GPS 76, in its preferred form, is a differential system (DGPS) 78 of the type commercially available and referred to as a SATLOK L-Band differentially corrected GPS unit. The use of the DGPS enhances the accuracy of the geographical locating ability of the system. As illustrated, this unit operates off of two satellites 79 and 81 and produces sub-meter accuracy. The data from the GPS is transmitted to the computer via standard NEMA format at 10 Hz frequency, line 83. The differential signal is received by the omni-star system which means that it receives its correction information from satellites 79 and 81. This allows for continental coverage at all times. This unit is also connected to the daylight readable front mounted display 46 that allows the pilot to view signal quality as well as all times without having to look inside the cockpit. **The GPS sends real time corrected latitude/longitude readings to the computer** and the computer is then able to perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing. The GPS unit 76, particularly its antenna, can be supported at a convenient position on the exterior of the aircraft fuselage."), 7:59-61 ("**The data storage 44 can be in the form of CDs and/or removable hard drives, again interconnected with the onboard computer.**"),

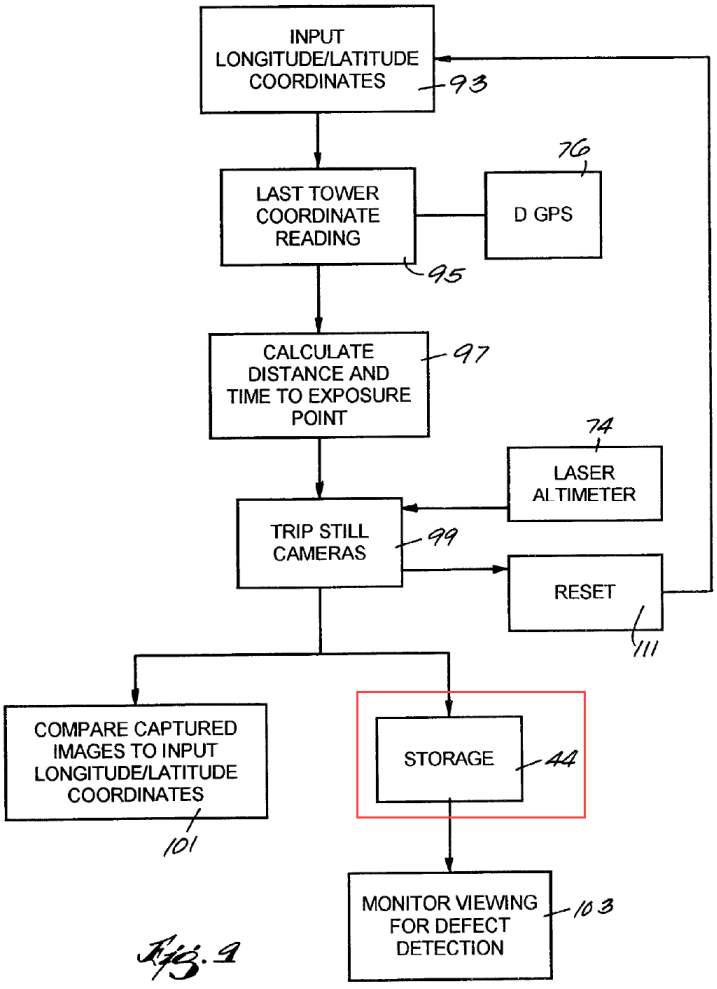
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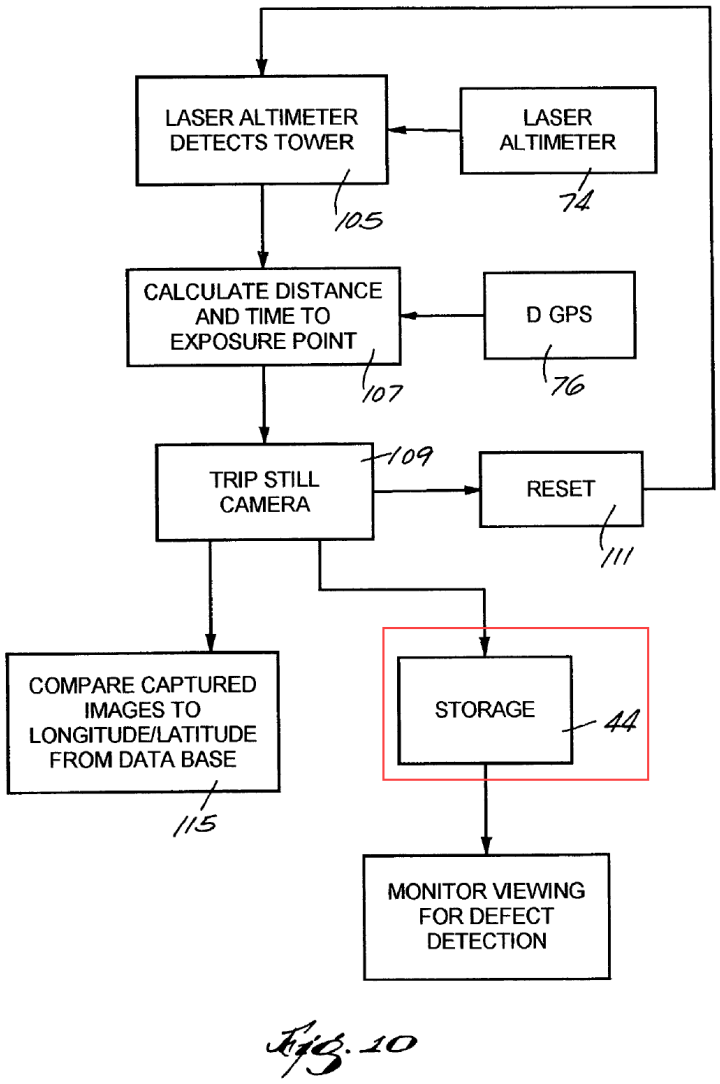
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	8:65-9:5 ("**A laser survey module (i.e., terrain mapping) has the computer recording all the GPS data strings as well as continuous laser readings 91 into a text file.** This file also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower the same as was described above in connection with the video survey module."), 9:14-31 ("In the GPS camera trip mode (FIG. 9), the GPS camera trip software module requires that the computer be given the latitude/longitude location of every tower that is to be filmed. The computer then steadily calculates the distance from a last GPS reading at 95 the last tower encountered to the first tower location to be encountered after that last tower GPS reading. The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., arrive at a particular desired exposure point for the still cameras a predetermined distance past the tower. The programming allows for varying the preselected distance, and thus the exposure point, as required or desired. The system is reset 101 with the next trip location being loaded into the computer and the camera trip program starts over again. **During the camera trip the computer program records the time and location of the trip into a separate file for post processing of the images.**"), 9:32-39 ("The laser altimeter trip software module has the computer responding to the input from the laser altimeter signifying the laser altimeter has identified a tower structure. The program then calculates, using the ground speed, to apply the proper time delay to trigger the still cameras at the desired exposure point. Again **the program records the time of the trip along with the geographic longitude/latitude coordinates of that tower location**."), 9:40-47 ("A post processing software module is provided to perform two separate duties. One is to extract

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	latitude/longitude readings of every tower structure and the other 101 is to coordinate the captured images with the original trip file containing the tower locations and identify any possible missed or extra images and then label all images to pre-determined standards, i.e., an AIS (asset inventory system) format."), 11:19-28 ("Whichever mode of operation is used, **the imaging data acquired is transmitted to the suitable storage media 44, for example, CDs or removable hard drives**, for later downloading. This downloading can be for one of two purposes. **In the instance of archiving the location of the tower structures it would be to establish the basic database for the transmission line company.** In another mode, it would be downloaded and compared with the already existing database for the location of the tower structures to identify any tower structures that may have been missed in the fly over 101 (FIG. 9)."), Figs.8-10. 

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	 Fig. 9

Claim 1	Prior Art
	 Fig. 10
[1.e]: the computer system executing image and data acquiring	**Loewen discloses or renders obvious this limitation.** **Loewen discloses the computer system** (*see* cl.1.d) **executing image and data acquiring software reading**[7] **said first and second image-data signals and said at least one geo-locating signal** (*e.g.*, "an onboard computer (a central

[7] POSITA would have understood Loewen's reference to "reading" data as accessing the data. This is consistent with how the '657 patent uses the term "reading" (*e.g.*, EX1001, 3:15-17 ("***reading*** the data file"); *see also, e.g.*, 5:33-38 ("Memory… includes… ***read***-only memory")), as well as its common usage by POSITA at the time.

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software reading[] said first and second image-data signals and said at least one geo-locating signal, said image and data acquiring software associating each said first or second image-data signal with a corresponding said at least one geo-locating signal for each image-capturing event; and	processing unit) containing operational software and operatively connected to the cameras and the tower detecting device" (*e.g.*, GPS and/or laser altimeter); "airborne inspection software" including "airborne capture software" that, *e.g.*, "has the computer recording all the GPS data strings as well as continuous laser readings" and receives the "image of a particular tower" and "post processing software module" that, *e.g.*, "extract[s] latitude/longitude readings of every tower structure" and "coordinate[s] the capture images with the original trip file"; "software programing… embedding the longitude/latitude coordinates for… the still camera output… pursuant to operational instructions, in association with the image of a particular tower"; "interaction between the onboard computer and the various pieces of system equipment are all coordinated and rendered operable on the basis of appropriate operating or executable software programs")**, said image and data acquiring software associating each said first or second image-data signal with a corresponding said at least one geo-locating signal for each image-capturing event** (*e.g.*, "[w]ith the appropriate software programming as mentioned above, … embedding the longitude/latitude coordinates for… the still camera output pursuant to operational instructions, in association with the image"; "coordinat[ing] the captured images with the original trip file containing the tower locations… label all images to pre-determined standards"; "embedding of geographical location… with images captured by both the still and video cameras"; "recording of the tower location in longitude/latitude coordinates in association with the image of each tower"; "longitude/latitude coordinates are identified by the GPS and embedded in the imaging database in association with the particular tower structure")**.** *See, e.g.*, EX1004, 1:16-24 ("**This invention relates to an airborne inventory and inspection system designed to obtain high resolution images of electric transmission power lines, the power line right-of-way and the support structure towers, along with a record of the respective location of the power line towers**, which system is an

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	improvement over current accepted systems and can be performed at a cost that makes use of this system more cost effective than alternatives available to the electrical power transmission industry."), 3:3-10 ("The still cameras exposure is automated by including in the system a capability for detecting a tower structure and **an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device**. The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line."), 3:37-50 ("The GPS, in combination with the onboard computer, continuously provides the position of the aircraft in longitude and latitude coordinates. In accordance with this system, **that data is transmitted to the onboard computer and, in accordance with another aspect of this system, is embedded in the collected data in association with the image of a particular tower structure so that the geographic location of the tower is associated with the image of that tower. This recording of the tower location in longitude/latitude coordinates in association with the image of each tower provides an inventory database of all of the towers along a particular transmission line. The embedding of geographical location can be done in association with images captured by both the still and video cameras.**"), 3:51-57 ("**The still and video images, along with the geographic coordinates are transmitted to data storage units on board the aircraft for post processing or other future use as desired**. For example, post processing can be visual inspection, tower by tower, on a suitable monitor for detection of structural defects."), 7:13-31 ("The cameras provide the image-acquiring portion of the overall system. That system also includes a geographic

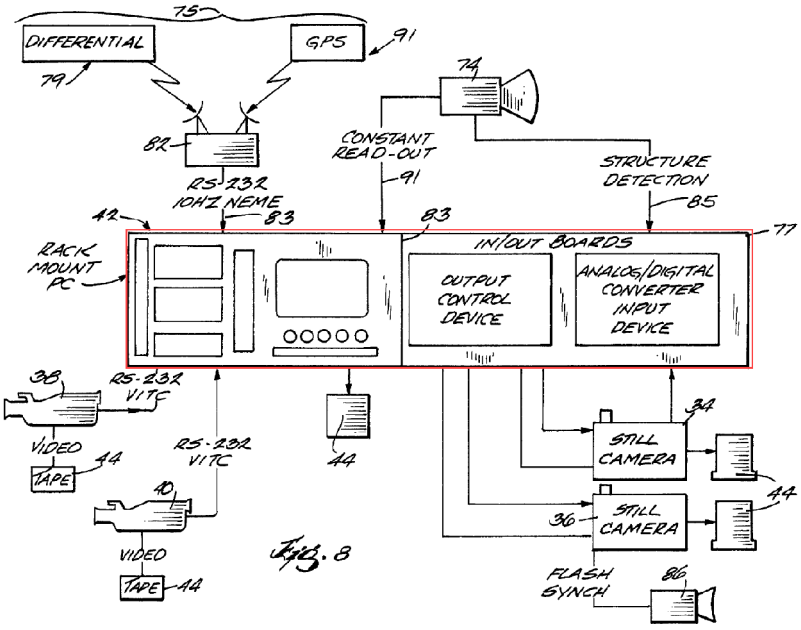
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	positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment. The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer. The onboard computer receives and sends out all its required signals via conventional RS-232 ports. The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status. Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."), 7:34-55 ("In the preferred embodiment, the GPS 76, in its preferred form, is a differential system (DGPS) 78 of the type commercially available and referred to as a SATLOK L-Band differentially corrected GPS unit. The use of the DGPS enhances the accuracy of the geographical locating ability of the system. As illustrated, this unit operates off of two satellites 79 and 81 and produces sub-meter accuracy. The data from the GPS is transmitted to the computer via standard NEMA format at 10 Hz frequency, line 83. The differential signal is received by the omni-star system which means that it receives its correction information from satellites 79 and 81. This allows for continental coverage at all times. This unit is also connected to the daylight readable front mounted display 46 that allows the pilot to view signal quality as well as all times without having to look inside the cockpit. **The GPS sends real time corrected latitude/longitude readings to the computer and the computer is then able to perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing.** The GPS unit 76, particularly its antenna, can be supported at a convenient position on the exterior of the aircraft fuselage."),

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	8:35-43, ("[T]he interaction between the onboard computer and the various pieces of system equipment are all coordinated and rendered operable on the basis of appropriate operating or executable software programs which are a functional part of the onboard computer operation. The actual details of the Software programming are not essential to an understanding of this invention and can be achieved with conventional programming techniques."), 8:47-53 ("In general terms, the airborne inspection software is comprised of two setup stages, airborne capture and post processing. The airborne capture software can be considered as being made up of different operational modules that can be run either separately, or together as needed. **The modules include a video module, a laser survey module, a GPS camera trip module, and/or laser altimeter trip module.**"), 9:6-13 ("The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude. **With the appropriate software programming as mentioned above, the system is capable of embedding the longitude/latitude coordinates for** either the video output or **the still camera output. That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association with the image of a particular tower.**"), 9:40-47 ("A post processing software module is provided to perform two separate duties. One is to extract latitude/longitude readings of every tower structure and the other 101 is to coordinate the captured images with the original trip file containing the tower locations and identify any possible missed or extra images and then label all images to pre-determined standards, i.e., an AIS (asset inventory system) format."), 10:4-13 ("More particularly and in accordance with the alternative embodiment of this invention and with reference to

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	FIG. 10, the laser altimeter 74 will detect the passage of the aircraft over a tower structure and generate a signal at that point. The signal is used to enable the system to **embed the longitude/latitude coordinates of that tower location on the corresponding tower image,** either the output from the video or **the output from the still cameras**, or both. This provides a continuous identification of the geographical location of the towers in the power line."), Fig.8.  POSITA would have understood that, for each image-capturing event, Loewen's computer system (including its software that executes the functions of Loewen's system) associates each image-data signal from Loewen's image-capturing devices (*e.g.*, still cameras) with the geo-locating signal generated by Loewen's laser altimeter. Indeed, Loewen expressly discloses that its laser altimeter generates "continuous laser readings" and that those readings are stored in "a text file" that "also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower the

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	same as was described above in connection with the video survey module," *e.g.*, EX1004, 8:65-9:5, which states that collected geo-locating information is "saved as a single integrated text file for post processing" to "provide a database of the right-of-way, all of the towers along the right-of-way, and the longitude/latitude coordinates for each tower," *e.g.*, EX1004, 8:54-64. Loewen further explains that its "post processing software module… coordinate[s] the captured images with the original trip file containing the tower locations" (which POSITA would have understood to be the "integrated text file for post processing," which contains the "continuous laser readings" from the laser altimeter), and "label all images to pre-determined standards." Thus Loewen expressly discloses that its computer system (including software executing the function's of Loewen's system) associates (as a result of either or both of Loewen's "coordinat[ing]" and "label[ing]") each image-data signal from Loewen's image-capturing devices (*e.g.*, still cameras) with the corresponding geo-locating signals generated by Loewen's laser altimeter. To the extent it is argued that further disclosure of Loewen's computer system software associating each image-data signal from Loewen's image capturing devices with the geo-locating signals generated by Loewen's laser altimeter, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed computer system associating geo-locating signals (such as GPS signals) with image-data signals captured by Loewen's image-capturing devices using Loewen's additional disclosure of laser altimeter signals corresponding to each image-capturing event, such that in the resulting system Loewen's computer system additionally associates each image-data signal with a corresponding laser altimeter signal. POSITA would have recognized that implementing Loewen's system with this additional geo-locating signal associated with Loewen's image-data signals would have advantageously permitted POSITA to record the system's height and the height of objects captured in images in order to derive more accurate

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	georeferenced imagery. Further, POSITA would have recognized that associating an additional geo-locating signal with Loewen's image-data signals would have been beneficial because it would have added further precision to the georeferencing performed by Loewen's computer system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* n.11.
[1.f]: wherein the computer system transmits image-capture signals to the first image-capturing device and the second image-capturing device to cause the first and second image-capturing devices to capture images, and wherein the computer	**Loewen in view of Fujimoto discloses or renders obvious this limitation.** **Loewen discloses that the computer system** (*see* cl.1.d) **transmits image-capture signals to the first image-capturing device and the second image-capturing device** (*see* cl.1.a, cl.1.b) **to cause the first and second image-capturing devices to capture images** (*e.g.*, "still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device;" "still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line"; "still camera" "trigger[ed]… to acquire the images"; "[to] fire the still cameras, the computer must pre-arm the camera prior to… the actual trip"; "cameras… trigger[ed] based on actual detection of the presence of the tower structure"; *see also* cl.1.a; cl.1.b)**.**[9]

[9] Loewen expressly discloses the use of a GPS and altimeter to transmit a signal to Loewen's computer system to trigger Loewen's still cameras to capture images of, *e.g.*, "exposure points along the transmission line," including when the onboard computer detects the presence of a "tower structure." *E.g.*, EX1004, Abstract, 3:3-10. Loewen also discloses capturing "continuous laser readings" of, *e.g.*, "terrain" within the right-of-way, *e.g.*, EX1004, 8:65-9:5, and that Loewen's laser altimeter sends a signal to Loewen's onboard computer to trigger Loewen's still cameras to

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system controls the first and	

capture an image when, *e.g.*, the laser altimeter detects a difference in height of the aircraft above a structure such as a tower, "as compared to height of the aircraft above the terrain," *e.g.*, EX1004, 8:27-35. Based on these disclosures, POSITA would have understood that Loewen's laser altimeter would also have detected, *e.g.*, the presence of structures or objects in the right-of-way, and upon detection of such structures or objects would send a signal to Loewen's computer, which in turn would have triggered Loewen's still cameras to capture images of such structures or objects when detected, consistent with Loewen's teachings that its system obtains information about and "inspect[s] the right-of-way to "to detect problems in the right-of-way," such as an unauthorized structure or vehicle." *E.g.*, EX1004, 1:28-53, 2:19-21, 5:34-42 ("inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees and other plant growth or the like have encroached into the right-of-way and is presenting a potential interference with the transmission lines"). Thus, Loewen expressly discloses that its computer system transmits image-capture signals to Loewen's image-capturing devices to capture images of the right-of-way in response to Loewen's laser altimeter detecting structures or objects therein. To the extent it is argued further disclosure of transmitting image-capture signals to Loewen's image-capturing devices to capture images of the right-of-way in response to Loewen's laser altimeter detecting structures or objects therein is required, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed computer system, which transmits image-capture signals to the first image-capturing device and the second image-capturing device, to cause the first and second image-capturing devices to capture images in response to Loewen's laser altimeter detecting structures or objects in the right-of-way. POSITA would have recognized that doing so would have advantageously triggered capture of images when Loewen's laser altimeter sensed the actual presence of structures or objects in the right-of-way, in furtherance of Loewen's express goal of "inspect[ing] the integrity of the right-of-way" and "in a cost-effective manner." EX1004, 2:19-21. For POSITA, this would have been an obvious, routine implementation choice and (particularly given Loewen's express disclosure of triggering the capture of images using Loewen's still cameras as a result of signals from Loewen's laser altimeter) it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* n.11.

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second image-capturing devices separately.[8]	**Fujimoto discloses controlling multiple image-capturing devices separately** (*e.g.*, "a computerized control for opening the shutters of a plurality of cameras independently of one another"; "computerized control for aerial photography… each shutter… driven at independently different interval time")**.** *See, e.g.*, EX1004, Abstract ("A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees. The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. **The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be**

[8] As discussed (*see* §V.c), the term "the computer system controls the first and second image-capturing devices separately" requires "control data sent by the computer system that cause image-capturing devices to capture images at different instants and/or at different intervals." Loewen in view of Fujimoto renders obvious this limitation.

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	photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way."), 3:3-10 ("**The still cameras exposure is automated by including in the system a capability for detecting a tower structure and an onboard computer (a central processing unit) containing operational software and operatively connected to the cameras and the tower detecting device. The still cameras, computer, and detection capability are operationally interconnected to automatically activate the still cameras at the exposure points along the transmission line.**"),[10] 4:1-13 ("When the alternative of preloaded longitude/latitude coordinates is used, the **GPS unit is used in the activation of the still cameras.** More particularly, the GPS continuously transmits longitude/latitude coordinates to the computer and the computer determines, from the preloaded coordinate information, the longitude and latitude coordinates of the next or approaching tower and the distance to the next tower and to the next still camera exposure point. **The computer then calculates the time delay, taking into account the ground speed of the aircraft, until the aircraft arrives at the exposure point where the still cameras are to be operated**

[10] While claim 1 does not require triggering the image-capturing devices in response to receiving a geo-locating signal, I include detailed disclosures here concerning Loewen's use of both GPS and altimeter signals transmitted to Loewen's onboard computer to cause the onboard computer to trigger Loewen's image-capturing devices as pertinent not only to the broader requirements of claim 1, but also as to coverage of narrower later limitations, including, *e.g.*, cl.4, cl.20, cl.21, and cl.26.

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Claim 1	Prior Art
	to capture the image. While this is taking place, the system is reset to capture the images of the next tower."), 6:31-58 ("The digital still cameras are supported in the pod by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The cameras look through a short tunnel section 56 of the pod housing. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses. The still cameras are preferably Kodak DCS-560 digital still cameras. These cameras produce digital still images at resolutions of over 2000 by 3000 pixels. These cameras capture images at the rate of 1 image per 4.5 seconds and are used to capture images of the tower structures 10 at their particular locations. **The still cameras write their information to a removable hard drive (conventional and therefore not shown in detail) incorporated and operatively associated with the onboard computer 42 and data storage units 44, but the cameras could write their information directly to the onboard computer via a well known and conventional firewire connection.** To properly fire the still cameras, the computer must pre-arm the camera prior to tripping the shutters to eliminate inconsistent trip delay times. This is preferably preformed ½ second prior to the actual trip. As will be described more completely hereinafter, the actual trip time is calculated either by using a GPS location and known structure locations, or by using a laser altimeter."), 7:13-31 ("The cameras provide the image-acquiring portion of the overall system. **That system also includes a geographic positioning system (GPS) 72, a mechanism 74 for triggering the still cameras to acquire the images of the tower structure, and related support equipment.** The onboard aircraft computer 42 is interconnected with the GPS and trigger system, and also the data storage unit 44 which is also interconnected with the onboard computer. The onboard computer receives and sends out all its required signals via

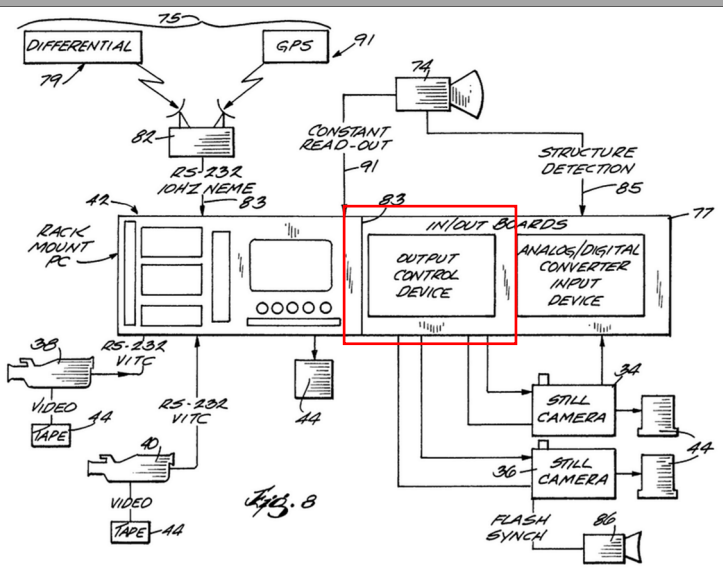
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Claim 1	Prior Art
	conventional RS-232 ports. **The computer is connected to and operatively associated with a multi-relay control and separate in/out interface board 77 that allows it to control various camera functions as well as monitor the equipment's status.** Various monitoring devices such as the flat panel displays and/or LCD 46 can be mounted in the aircraft as desired to provide for real time review of the system operation. This equipment and the various connections thereof in the system are conventional and therefore are not shown in the drawings nor described in detail."), 7:34-55 ("In the preferred embodiment, the GPS 76, in its preferred form, is a differential system (DGPS) 78 of the type commercially available and referred to as a SATLOK L-Band differentially corrected GPS unit. The use of the DGPS enhances the accuracy of the geographical locating ability of the system. As illustrated, this unit operates off of two satellites 79 and 81 and produces sub-meter accuracy. The data from the GPS is transmitted to the computer via standard NEMA format at 10 Hz frequency, line 83. The differential signal is received by the omni-star system which means that it receives its correction information from satellites 79 and 81. This allows for continental coverage at all times. This unit is also connected to the daylight readable front mounted display 46 that allows the pilot to view signal quality as well as all times without having to look inside the cockpit. **The GPS sends real time corrected latitude/longitude readings to the computer and the computer is then able to perform real time coordination of camera tripping and latitude/longitude signals for inventory or survey processing.** The GPS unit 76, particularly its antenna, can be supported at a convenient position on the exterior of the aircraft fuselage."), 10:50-67 ("In this embodiment, **the inspection system utilizes the inputted geographic coordinates to arm and trigger the still cameras**. More particularly, the **GPS 76 constantly monitors the location of the aircraft** relative to the tower structure geographical database. When the system detects that

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	it has flown over a particular tower structure, that being accomplished when the detected longitude/latitude coordinates correspond to the inputted database longitude/latitude coordinates 95 (FIG. 9), the computer system is advised that the next tower will be available at a particular upcoming set of longitude/latitude coordinates. The computer then calculates 97 (FIG. 9), based on the ground speed of the aircraft, the time necessary to close the distance to the approaching tower and fly past the tower to a preselected point (the exposure point), measured in feet from the tower at which point **the still cameras are activated to record the images** 99 (FIG. 9). The system is reset 111 for the next tower to be photographed."), 11:1-14 ("In another embodiment, the physical detection of the presence of the tower structure is sensed and the system is enabled on that basis 105 (FIG. 10). That is, the laser altimeter is continually sensing the profile of the terrain with its downwardly directed beam. **As the aircraft passes over the tower structure it detects a major difference in distance from the aircraft to the top of the tower structure as compared to the distance from the aircraft to the terrain. That signal is transmitted to the computer system which then accomplishes a calculation 107 (FIG. 10) based on ground speed to enable and trigger the camera shutters 109 (FIG. 10) at a preselected distance past the tower structure**. The system is reset 111 for the next tower to be photographed."), 11:15-18 ("The second embodiment wherein **the cameras are enabled to trigger based on actual detection of the presence of the tower structure** is preferred as it is more consistent and reliable in operation."), Fig.8.

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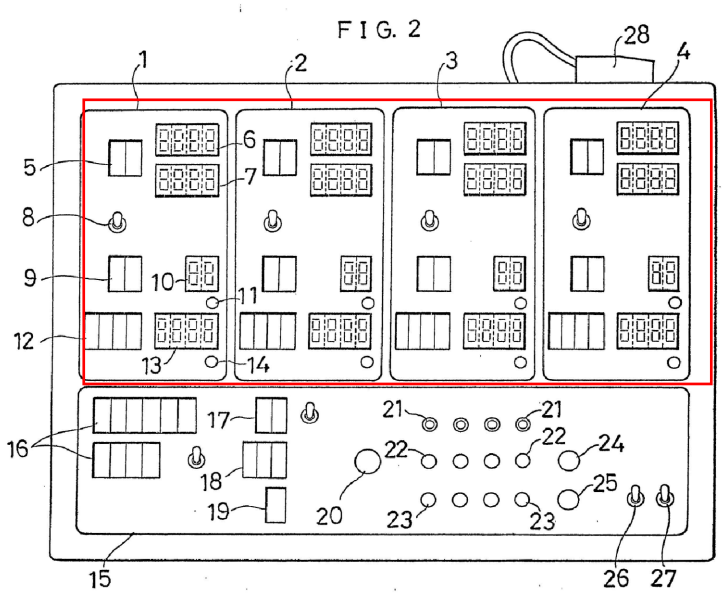
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	 Fig. 8 *See, e.g.*, EX1005, Abstract ("**For an aeroplane having two or more cameras with different lens angles, the intervals between operations of the shutters of all the cameras are controlled to ensure full coverage of the area being photographed without wastage of film.** The inputs to the computer (31) are of aircraft speed (17) and altitude (18), percentage overlap (19) between successive pictures, and lens angle (5). These are used to calculate for each camera the interval between exposures, which is stored in a latch circuit (32) and displayed by indicator (6). Start and stop buttons (22) and (23) control an interval timer (33) which through gate (34), amplifier (35), and shutter circuit (36) effects the operation of the shutter at intervals determined by the value stored in latch (32). Facilities are also described for transcribing reference data onto the film."), ¶0001 ("The present invention relates to a computerized control for aerial photography, and more particularly, to a computerized control for aerial photography for use in association with aerial cameras mounted in an aeroplane. The cameras are mounted with different lens angles to the ground but with equal overlap rates, and **take photographs in succession at different altitudes and speeds along the line of flight under the computerized control**."),

Claim 1	Prior Art
	¶0004 ("The present invention aims at overcoming such difficulties, and has for its object to provide **a computerized control for opening the shutters of a plurality of cameras independently of one another** thereby to secure a series of photographs of the ground without the waste of film."), ¶0006 ("According to the invention, a computerized control for aerial photography includes means for inputting as data the altitude and speed of flight, means for setting the overlap rate between the adjacent photographs and the lens angles, an arithmetic unit for calculating interval time through arithmetical operations on said altitude, speed, overlap rate and lens angles, and an output device for producing shutter driving signals at said interval time resulting from said arithmetical operations, said. signals being produced with respect to all the cameras mounted in the aeroplane, **thereby enabling each shutter to be driven at independently different interval time**."), ¶0008 ("**Referring to Figure 2 the reference numerals 1, 2, 3 and 4 designate a first block, a second block, a third block and a fourth block, respectively, each of which accommodates an aerial camera. This means that the illustrated control system can control four cameras.** In addition to the camera, each block is provided with a digital switch 5 for setting and indicating the lens angle, a digital display 6 for indicating the interval (second) calculated by the computer, a digital display 7 for indicating the time (seconds) remaining before starting photo-taking, a camera operation switch 8, a digital switch 9 for setting the number of exposures to be photographed in, a digital display 10 for indicating the number of unphotographed exposures counted down from the set number, a press button 11 for presetting the set value of the digital switch 9 to a down-counter, a digital switch 12 for setting the number of exposures to have been photographed in by the previous day, a digital display 13 for indicating the total number of exposures which have been photographed in as of that day, and a press button 14 for presetting the set value of the digital switch 12 to an up-counter."),

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	¶0010 ("Referring to Figure 3 the data set by the switches 17, 18, 19 and 5, that is, the speed, the altitude, the overlap rate and the lens angle, are input to a computer 31 as BCD (binary coded decimal) codes. The reference numeral 32 designates a latch circuit at which the desired interval is temporarily memoried, the interval being calculated in accordance with the formula referred to below. When the press button 20 is actuated, the computer 31 is energized for about 3 seconds, and starts operation. The results of operation are stored in the latch circuit 32 for each camera, and then the computer 31 is de-energized. Such short-term energization of the computer is intended to save the life of the battery and secure a prolonged photo-taking in flight. The memory in each latch circuit 32 is not only indicated on the interval display 6 but also it is applied to the interval timer 33. **The interval timer 33, once the button 22 has been pressed, continues to output pulses at the intervals specified by the latch circuit 32 until the stop button 23 is pressed, which pulses cause the shutters of the cameras to open.** At the same time, the interval timer 33 outputs to the display 7 so as to indicate the time remaining before starting the photo-taking. A gate circuit 34 guides the pulses from the interval timer 33 to an amplifier 35 for opening the shutter, and when one interrupt shutter button 21 is actuated, it provides a single gate output independently of the state of the interval timer 33. The output of each amplifier 35 is connected to a shutter circuit 36 of the camera."), Cl.1 ("**A computerized control for aerial photography**, comprising means for inputting as data the altitude and speed of flight, means for setting the overlap rate between the adjacent photographs and the lens angles, an arithmetic unit for calculating interval time through arithmetical operations on said altitude, speed, overlap rate and lens angles, and an output device for producing shutter driving signals at said interval time resulting from said arithmetical operations, said **signals being produced with respect to all the cameras mounted in the aeroplane, thereby [e]nabling each shutter to be driven at independently different interval time**.").

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	Fig.2:  POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed computer system that transmits image-capture signals to the first image-capturing device and the second image-capturing devices to cause the first and second image-capturing devices to capture images using Fujimoto's advantageous teachings of using *separate* controls for multiple image-capturing devices. POSITA would have recognized that doing so would advantageously prevent capturing wholly or partially unnecessary and/or duplicative images that would be captured by simultaneous triggering of both cameras, thus reducing the storage space used by the system, advantageously increasing the number of structures that can be captured by the combined system, and reducing the need to process unnecessary and/or duplicative data. Indeed, although not required for obviousness, Fujimoto expressly teaches that independent camera control beneficially avoids "waste of film." *E.g.*, EX1005, ¶¶0003, 0004. Reducing duplicative imagery (and the resulting waste of storage space) would also enable the capture of higher-resolution images (which require

Claim 1	Prior Art
	more storage than lower-resolution images, and which Loewen expressly discloses are advantageous, *e.g.*, EX1004, 2:30-64, 11:47-51), thereby enabling the combined system to provide more detail of captured structures or other capture objectives, and enabling the devotion of more system resources to analyzing such images (rather than, *e.g.*, unnecessary and/or duplicative data), increasing the usefulness of such imagery by allowing a user to discern more information from such images. Additionally, POSITA would have recognized that controlling both cameras independently would advantageously account for the different capture timing requirements and overlap rates that would arise in a multi-camera image capture system that employs cameras with different resolutions, or employs cameras arranged to capture different oblique angles or a mix of oblique and orthogonal angles. This would allow POSITA to efficiently capture additional usable information not available if the cameras were triggered together. Further, POSITA would have recognized that allowing for greater control of camera timing could beneficially account for situations where one camera's view could be at least partially obscured if it were triggered together with another camera or cameras. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[11]

[11] This and other combinations proposed in the Grounds are implemented in well-understood, wholly predictable technology (*e.g.*, hardware and software), further underscoring POSITA's reasonable expectation of success for each combination. As the '657 patent itself acknowledges, hardware capable of implementing the '657 patent's claims was already known to POSITA. EX1001, 4:23-35 ("Image-capturing devices… for example, conventional cameras, digital cameras, digital sensors… or other suitable image-capturing devices" that have "**known** characteristics"), 4:55-58 ("INU is a **conventional** inertial navigation unit"), 5:6-26, 5:27-47 ("image-capturing computer system… for example, a **conventional** laptop personal computer"); *see also*, *e.g.*, EX1004, 6:44-51 ("**conventional** firewire connections"), 7:20-22 ("onboard computer receives and sends out all its required signals via **conventional** RS-232 ports"), 7:56-58 ("trigger system 74 in

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Claim 3	Prior Art
[3.pre]: The system of claim 1, wherein said at least one geo-locating device and said at least one geo-locating signal respectively comprise:	**Loewen in view of Fujimoto, Mostafa, and Garrot renders obvious claim 3.** **Loewen in view of Fujimoto renders obvious the system of claim 1 and includes at least one geo-locating device and said at least one geo-locating signal respectively comprise** (*see* cl.1)**.** The particular geo-locating device and geo-locating signals of the remaining of claim 3 are discussed below.
[3.a]: a clock issuing to said image-capturing computer system time data signals indicative of a time of each said image-capturing event;	**Loewen discloses or renders obvious this limitation.**

the preferred embodiment is a laser altimeter, a **conventional and commercially available** device"), 8:35-46 ("**conventional** programming techniques").

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Claim 3	Prior Art
	Loewen discloses a clock[12] issuing to said image-capturing computer system time data signals[13] indicative of a time of each said image-capturing event; (*e.g.*, "During the camera trip the computer program records the time and location of the trip into a

[12] To the extent it is argued further disclosure of a clock is required, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with a GPS-detected location indicative at least in part of a geo-location of each of a first and second associated image capturing device (in the combined Loewen-Fujimoto system, *see* cl.1.f) using a clock (which was a well-known component of image-capturing systems, *e.g.*, EX1005, ¶¶9, 17 ("electronic clock"), ("electronic clock 40 includes a clock pulse generator")), issuing to Loewen's computer system time data signals indicative of a time of each image-capturing event. POSITA would have recognized that doing so would have advantageously provided additional data, which would have been beneficial because it would add further precision to the georeferencing performed in Loewen. Additionally, POSITA would have recognized that including time data signals from a clock indicative of a time of each image-capturing event would have advantageously provided information about the time of day at which an image was captured (consistent with Loewen's express use of time data (EX1004, Abstract, 4:26-30, 6:54-57, 9:29-31), increasing the usability of such images and efficiency of the system by, *e.g.*, providing the ability for users to ascertain the time at which an image was taken to better track and inventory the status of inspected power lines and towers and the state of rights-of-way (including comparisons over time at, *e.g.*, the same time of day) and, in the case of images taken with low visibility due to poor lighting conditions at a particular time of day, to permit scheduling future image-capturing flights to avoid that time of day. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success. *See* n.11.

[13] Loewen expressly discloses its system "records the time" of the "camera trip" into a "separate file," and thus expressly discloses transmitting a time data signal from the clock to the separate data file. EX1004, 9:29-31. POSITA would have understood that Loewen thus discloses that the "time" stored in this file is indicative of a geo-location of Loewen's image-capturing devices at each image-capturing event because the time of the camera trip is recorded alongside the longitude/latitude coordinates of the image captured at that time.

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Claim 3	Prior Art
	separate file for post processing of the images."; "the program records the time of the [camera] trip along with the geographic longitude/latitude coordinates of that tower location")**.** *See, e.g.*, EX1004, 8:65-9:5 ("A laser survey module (i.e., terrain mapping) has the computer recording all the GPS data strings as well as continuous laser readings 91 into a text file. **This file also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower the same as was described above in connection with the video survey module.**"), 9:6-13 ("The GPS is capable of identifying the geographical coordinates for a given tower, longitude/latitude. **With the appropriate software programming as mentioned above, the system is capable of embedding the longitude/latitude coordinates for either the video output or the still camera output. That is, the longitude/latitude coordinates will be embedded, pursuant to appropriate operational instructions, in association with the image of a particular tower.**"), 1 9:14-31 ("In the GPS camera trip mode (FIG. 9), the GPS camera trip software module requires that the computer be given the latitude/longitude location of every tower that is to be filmed. The computer then steadily calculates the distance from a last GPS reading at 95 the last tower encountered to the first tower location to be encountered after that last tower GPS reading. The program calculates 97, using the aircraft ground speed, the time delay needed to trip 99 the camera after passing the upcoming structure a preselected distance, i.e., arrive at a particular desired exposure point for the still cameras a predetermined distance past the tower. The programming allows for varying the preselected distance, and thus the exposure point, as required or desired. The system is reset 101 with the next trip location being loaded into the computer and the camera trip program starts over again. **During the camera trip the computer program records the time and location of the trip into a separate file for post processing of the images.**"),

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Claim 3	Prior Art
	9:32-39 ("The laser altimeter trip software module has the computer responding to the input from the laser altimeter signifying the laser altimeter has identified a tower structure. The program then calculates, using the ground speed, to apply the proper time delay to trigger the still cameras at the desired exposure point. Again **the program records the time of the trip along with the geographic longitude/latitude coordinates of that tower location.**").
[3.b]: a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second image-capturing devices at each said image-capturing event;	**Loewen discloses this limitation.** **Loewen discloses a global-positioning system (GPS) receiver receiving GPS signals and issuing to said image-capturing computer system location data signals indicative of a longitude and latitude of said first or second image-capturing devices at each said image capturing event;** (*see* cl.1.c (mapping Loewen's "GPS"))**.**
[3.c]: an inertial	**Loewen in view of Mostafa renders obvious this limitation.**

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Claim 3	Prior Art
navigation unit (INU) issuing to said image-capturing computer system velocity data signals indicative of a velocity of said first or second image-capturing device at each said image-capturing event;	**Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c)**.** **Mostafa discloses an inertial navigation unit (INU) issuing velocity data signals indicative of a velocity of image-capturing devices at image-capturing events** (*e.g.*, "navigation data is collected using a Honeywell LRF III inertial navigation system"; "The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft.") to an image-capturing computer system. *See, e.g.*, EX1007, Abstract ("In this paper, the development and testing of an airborne fully digital multi-sensor system for digital mapping data acquisition is presented. **The system acquires two streams of data, namely, navigation (georeferencing) data and imaging data.** The navigation data are obtained by integrating an accurate strapdown inertial navigation system with a differential GPS system (DGPS). The imaging data are acquired by two low-cost digital cameras, configured in such a way so as to reduce their geometric limitations. The two cameras capture strips of overlapping nadir and oblique images. **The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft.** Thus, image exterior orientation information is extracted from the trajectory, during post-processing. This approach eliminates the need for ground control (GCP) when computing 3D positions of objects that appear in the field of view of the system imaging component. Two approaches for calibrating the system are presented, namely, terrestrial calibration and in-flight calibration. Test flights were conducted over the campus of The University of Calgary. Testing the system showed that best ground point positioning accuracy at 1:12,000 average image scale is 0.2 m (RMS) in easting and northing and 0.3 m (RMS) in height. Preliminary results indicate that major applications of such a system in the future are in the field of digital mapping, at scales of 1:5000 and smaller, and in the generation of digital elevation models for engineering applications."),

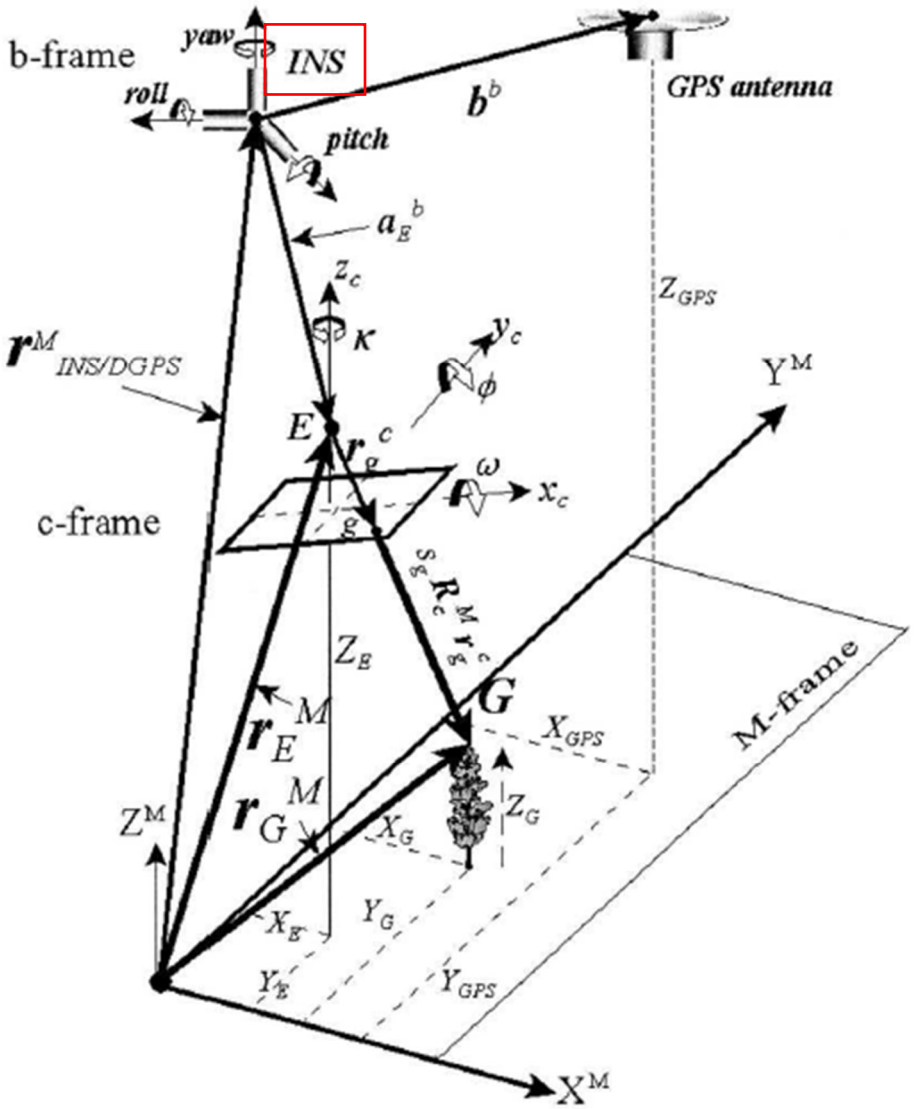
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Claim 3	Prior Art
	3-4 ("**The configuration shown in Fig. 2 acquires two separate streams of data, namely, the navigation and the imaging data. The navigation data is collected using a Honeywell LRF III inertial navigation system, and an Ashtech ZXII GPS receiver, connected to a portable computer for raw data acquisition and storage for subsequent post-mission processing.** The image data is collected by two low-cost Kodak DCS420c digital cameras equipped with a 1.5=1 K CCD chip (9 mm pixel resolution). **To synchronize the INS, GPS, and image data in a common time frame, the INS records are stamped in real-time by the Ashtech GPS receiver PPS (pulse per second) signal, while a Trimble GPS receiver event marker pulse is used to store the instant of time when an image is captured by one of the cameras. Therefore, all the data are synchronized in the GPS time frame during data logging. The data acquisition is controlled by a real-time data logging software which downloads the GPS/INS/imagery data to the host computers, and time tags the imagery and INS records by the GPS receiver-derived time pulse.**"), 9 ("The flight was done with wide turns to avoid signal blockage by aircraft banking and, thus, the roll angle was typically smaller than 158. Further, mission planning was done to ensure a good sun angle and good satellite sky distribution. Two master stations were kept running during the test period. One was located close to the airport and was occupied by a Trimble 4000 SSI, the other was on the rooftop of the engineering building and was occupied by an Ashtech Z XII receiver. This resulted in two independent GPS trajectories which, when compared, agreed to be better than 10 cm, which is typical for a 2–8-km baseline. These values indicate that each of the two independent solutions provides sufficiently high-precision camera exposure station position. The Ashtech GPS raw data together with the INS measured specific force and angular velocity raw data were processed using the KINGSPAD software. The Kalman filter-derived estimates of the positioning precision are 0.04, 0.05 and 0.09 m, for latitude, longitude and height, respectively. **For attitude, they are 0.00758, 0.00978 and 0.01528, for roll, pitch and yaw, respectively.**

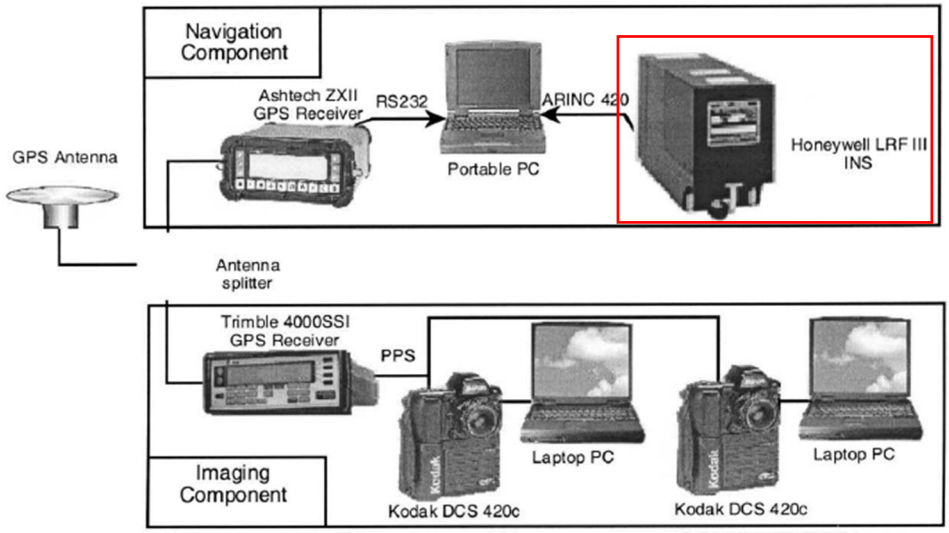
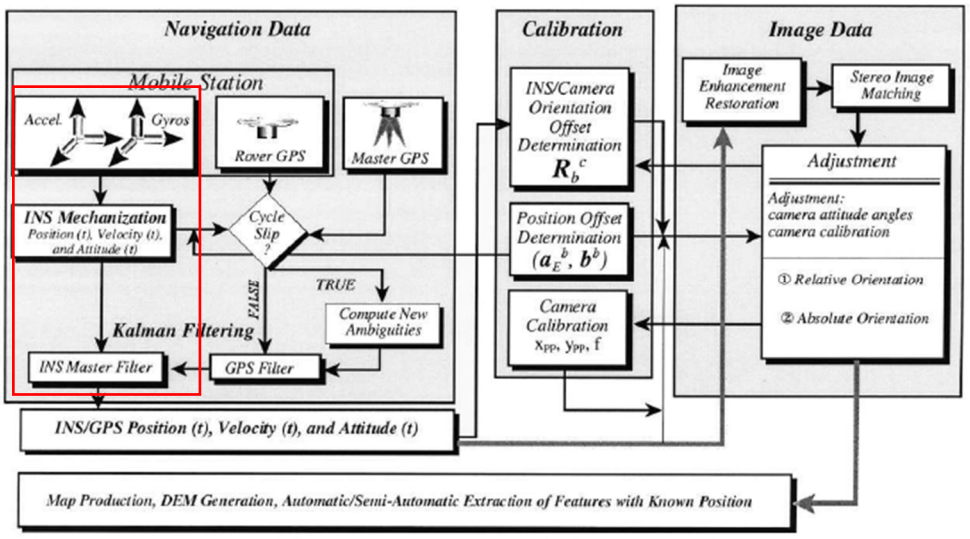
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Claim 3	Prior Art
	The GPS/INS interpolated position and attitude angles at each exposure station were used together with the imagery to analyse the system performance when using nadir plus oblique images. After preprocessing the GPS/INS data to compensate for the position and orientation offsets between the navigation and imaging sensors, the compensated position and attitude parameters were used as observable exterior orientation parameters (in M-frame) together with their standard deviations and the image point measurements from the commercial software package PCI OrthoEngine."), 12 ("The system developed here is at the prototype level and, thus, data acquisition was also implemented at the prototype level. For example, the multi-camera system containing two cameras for testing was implemented using two separate laptops and a GPS receiver to synchronise the acquired imagery to the GPS time frame. In addition, the navigation data was collected using a different host computer with a different GPS receiver. Further, a full inertial system and GPS receivers were used to acquire only the raw data from the IMU and the GPS cards. This significantly adds to the system budget and reduces system portability. **It is, therefore, recommended to design an industrial computer system that can accommodate the necessary boards for simultaneous navigation and image data acquisition. This would greatly improve system portability and cost.** Besides the work presented here, map production using the Kodak DCS series has been reported (cf. Congalton et al), 1998.. However, since these cameras are not designed for aerial surveys, the long-term stability of their calibration could be problematic and has to be well studied before using them in mapping."), Fig.1. Fig.2, Fig.5.

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Claim 3	Prior Art
	 Fig. 1. Elements of direct georeferencing (see explanations in text).

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Claim 3	Prior Art
	 Fig. 2. Hardware configuration.  Fig. 5. The multi-sensor system data-flow (in-flight calibration case). POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with, *e.g.*, a GPS-detected location indicative at least in part of a geo-location of each of a first and second associated image capturing and an altimeter indicative of an altitude of a first and second image-capturing device (in the combined Loewen-Fujimoto system, *see* cl.1.f) using Mostafa's advantageous teachings of an inertial navigation unit (INU) (which was a well-known and conventional component of aerial imaging systems

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	(*e.g.*, EX1008, 2:29-32 (discussing prior-art "inertial navigation systems")), issuing to an image-capturing computer system velocity data signals (where those velocity data signals are indicative of a velocity of an image-capturing device at image-capturing events). POSITA would have recognized that implementing the combined Loewen-Fujimoto system with this additional INU input (as taught in Mostafa) would have advantageously increased the system's imagery accuracy and advantageously provided a backup if, for example, during flight contact with the GPS satellite was lost, thus allowing the combined system to continue to track and record the location of its image-capturing devices based on INU data until contact with the GPS satellite was reestablished. Indeed, Mostafa itself expressly describes significant improved ground positioning accuracy when "[u]sing GPS/INS-aided" imagery. *E.g.*, EX1007 at 11 (noting oblique imagery with GPS/INS-aided block triangulation with nadir imagery "improved the ground positioning accuracy to 0.2m in planimetry (1σ) and 0.3m in height" compared to 0.5m planimetry and a height accuracy of 0.7m when using only a nadir stereopair and an extra oblique). Moreover, Fujimoto (which is part of the combined Loewen-Fujimoto system, *see* cl.1.f) expressly discloses the use of "speed of flight" and a "speedometer" (EX1005, 2, 7), further showing that incorporating velocity information would have been understood by POSITA to be been routine and beneficial. Further, POSITA would have recognized that additional sensors including an INS, as well, as for example, a compass, and gyroscope (discussed below), would have been beneficial because doing so would add further precision to the georeferencing performed in the combined Loewen-Fujimoto system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[14]
[3.d]: a gyroscope issuing to said image-	**Loewen in view of the Garrot renders obvious this limitation.** **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of**

[14] *See* n.11.

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Claim 3	Prior Art
capturing computer system a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of said first or second image-capturing device at each said image-capturing event;	**said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c)**.** **Garrot discloses a gyroscope issuing a pitch signal, a roll signal, and a yaw signal respectively indicative of a pitch, roll and yaw of image-capturing devices at image-capturing events;** (*e.g.*, "For each image event this file contains:… 5. Gyro pitch; 6. Gyro roll"; "pitch, roll, yaw") to a computer**.** *See, e.g.*, EX1006, 4:66-5:9 ("In a specific embodiment the sensor is an infrared sensor and the system for georeferencing the acquired signals is a receiver adapted to receive signals from a global positioning system. **In the specific embodiment, the means for compensating for tilt in the aircraft includes a vertical gyroscope, a magnetometer and software for controlling the gyroscope by a dedicated processor to produce signals indicative of the orientation of the aircraft. The software compensates for tilt in the acquired signals and uses the GPS signals, vertical gyroscope, magnetometer, and imaging constants to create an accurate mosaic of the images generated by the sensor.**"), 6:14-47 ("FIG. 1 is a block diagram of the imaging system 10 of the present invention. The inventive imaging system 10 collects and stores the necessary image, environmental, GPS, magnetic, inertial and timing data required to enable the Post Processing Program (described below) to produce high resolution, georeferenced imagery. The imaging system 10 is located on an aircraft or other airborne vehicle (not shown). In the illustrative embodiment, the system includes an infrared imager 12. Nonetheless, the teachings of the present invention may be applied to other types of imagers without departing from the scope thereof. The imager 12 is mounted on an image platform (IP) 11 within the aircraft such that the imager 12 is looking down at the target area. As the aircraft flies over a target area, the system 10 acquires discrete digital images that, in accordance with the present teachings, are subsequently mosaicked to produce the desired output image. As the aircraft flies a prescribed grid pattern to collect imagery representing the entire target area, the imager 12

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	acquires long wave radiographic infrared digital images. In addition, the imaging system 10 provides real-time navigation and system status information to the pilot and flight technician. A Global Positioning System (GPS) receiver 20 outputs precision position, velocity, and timing information. **A vertical gyroscope (gyro) 26 and magnetometer 24 which are hard mounted to the IP provide the imaging platform's pitch, roll, and heading data. Control of the vertical gyro 26 is aided by velocity and heading information from the GPS receiver 20 directed to a dedicated processor 50. The processor 50 calculates a smoothed acceleration and controls the erection mechanism of the gyro 26, yielding more accurate pitch and roll data. This information combined with the GPS data provides real-time georeferencing information which is logged during the flight session.**"), 6:48-7:12 ("In operation, the imaging system 10 collects digital imagery at specified intervals depending upon the flight altitude and aircraft speed. Imagery is collected within the flight zone, and is automatically disabled when outside of the flight zone or in a turn. An Airborne Computer Unit (ACU) 30 produces an image strobe command. This command is received by a Timing and Logic Unit (TLU) 18 and a corresponding signal is sent to a Digital Image Recorder (DIR) 16 just before the desired image frame. Digital image frames are constantly streaming into the DIR 16 from an Imager Controller Unit (ICU) 14 associated with the imager 12. This signal is optionally inhibited during a no-go condition (such as in a turn) produced by the continuous monitoring of the GPS Receiver 20 by the dedicated processor 50. The DIR responds by signaling the TLU that it is ready to record the next incoming digital image frame. The TLU monitors the analog video output from the imager which is synchronized to the digital image data, and extracts timing pulses from the video signal. The TLU sends a logger strobe pulse to a Data Logger Unit (DLU) 28 and to the ACU precisely in the middle of the next frame. The ACU time tags the logger strobe pulse, which is used to interpolate a position and altitude corresponding to the image capture event. **The DLU receives the pulse and immediately samples the gyro 26, magnetometer 24, and RH/Temperature**

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Claim 3	Prior Art
	sensors 22 and outputs this information via serial link to the ACU where it is time-stamped and logged to disk. Meanwhile, the DIR logs the desired image to its separate disk via a locally time tagged image file. The RH/Temperature sensors 22 serve to measure canopy air temperature differential and acquire relative humidity (RH) to calculate Vapor Pressure Defficit over the crop area."), 8:18-60 ("**Vehicle acceleration is calculated by the dedicated processor 50 for the purpose of controlling the erection mechanism of the vertical gyro 26. As mentioned above, the vertical gyro 26 resides on the imaging platform 11 and produces pitch and roll data needed for an accurate projection of each logged image frame.** The processor 50 consists of an embedded computer that receives GPS velocity, heading, time, and solution status information from the GPS receiver 20 at a 5 Hertz rate via a serial data link. The processor 50 controls the vertical gyroscope's 26 erection mechanism. FIG. 1A is a flow diagram of an illustrative implementation of software running on the acceleration processor. As shown in FIG. 1A, upon initial power-up, the processor reads in a configuration file, initializes all internal settings 100, the GPS data communications (COM) port 104, and resets the output pins 102. The output pins control the vertical gyroscope 26 and a status light that indicates the GPS solution status bit condition. When the GPS receiver 20 indicates that satellite tracking is occurring such that reliable GPS data is produced, the input serial data is assumed to be valid 106 and the GPS Data Valid pin 108 is asserted. Instantaneous Normal (roll) and axial (pitch) accelerations 110 are calculated and a second order digital filter 112 at a cut-off frequency of 0.5 Hz. is applied to each axis, and compared to an acceleration threshold 114 by processor 50. When the value in either axis is exceeded, the gyro is commanded to a free inertial state 116, otherwise the normal erection mechanism is active. Greatly smoothed pitch and roll data are produced because less of the vehicle accelerations influence the vertical gyro readings facilitating better image quality than is possible with an un-aided vertical gyro. The vertical gyro 26 contains an erection system that slowly seeks the gravity vector. The gravity vector is influenced by

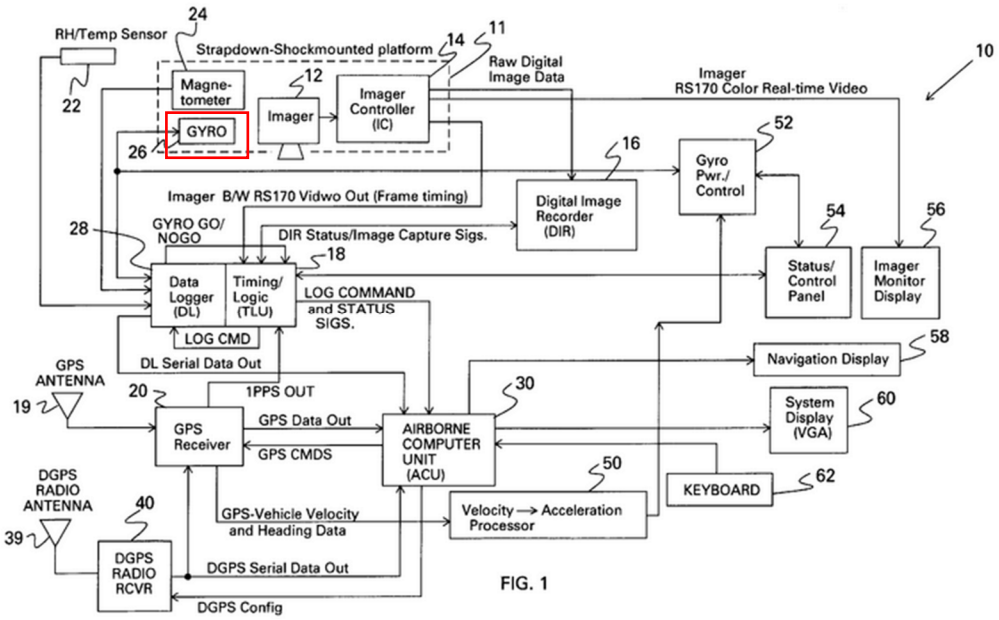
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Claim 3	Prior Art
	instantaneous and sustained accelerations. The gyro's pitch and roll readings will contain erroneous values if these accelerations are allowed to accumulate. The purpose of the processor 50 is to minimize the accelerations that can influence the vertical gyro by temporarily commanding the gyro into a free erection state (insensitive to any accelerations) during a GPS measured acceleration period which exceeds the predefined threshold. This cycle will repeat itself many times during a flight."), 10:25-32 ("**The Imaging Platform (IC) 11 contains the imager 12, gyro 26, magnetometer 24, and imager controller 14.** The IC is a rigid platform that is mounted to the aircraft via vibration isolated mounts. **The gyro and magnetometer are rigidly attached to the platform, as is the imager. Any relative motion (pitch, roll, yaw) that the imager experiences, will also be sensed by the gyro and magnetometer.**"), 10:61-11:18 ("**In the preferred embodiment, the gyro 26 is a Humphry's Instrument model # VG24-3116-1 vertical gyro.** It is mounted directly to the imager housing's mounting bracket. This device contains a 2 axis (pitch, roll) rotating gimbaled gyro element and a vertical erection system that actively seeks the vertical gravity vector. The erection system is disabled during sustained turns and accelerations automatically by the dedicated acceleration processor 50. A control panel 52 provides visual indication of the gyro status and includes override switches that can manually control the gyro. The magnetometer 24 is a TCM2-16 manufactured by Precision Navigation Inc. which is a solid state device. This device measures the earth's X, Y, and Z magnetic fields relative to the imaging platform. This data is used in conjunction with the vertical gyro's pitch and roll data taken concurrently to derive vehicle heading. This is an important feature, because in the inventive system, heading is essentially immune to vehicle accelerations. Heading values calculated from a magnetic sensing device depend upon accurate vertical inclination (pitch and roll values) at all times. Conventional sensors use an inexpensive on-board inclinometer which is useless on a dynamic platform such as an aircraft. The

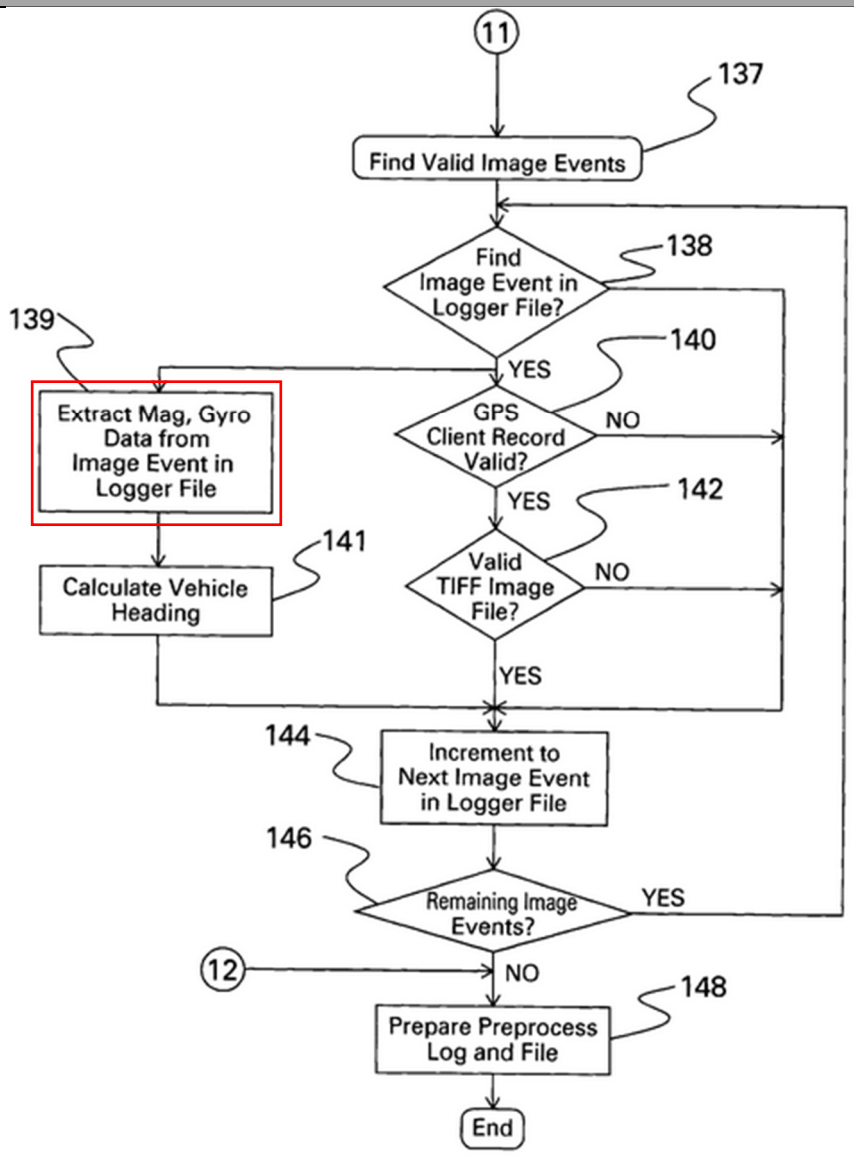
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Claim 3	Prior Art
	magnetometer sensor is oriented such that its pitch and roll planes align with the gyro's 26 pitch and roll axes.”), 15:30-40 (“The Data Logger Unit's (DLU) 28 serial data *.GR5 file is combined with its $ character time stamps file *.CH5 to create an ASCII file *.MK5. MK5 stands for "marked" data file from serial port #5 of the ACU 30. In the system 10 of FIG. 1, the Data Logger Unit 28 samples the vertical gyro analog output, the MET sensor's analog output, the Imager's inclinometer's analog output (not shown), digital status inputs/outputs, and the magnetometer 24 serial output. All of the analog inputs are converted to engineering units and this data is output in a formatted structure. A sample *.MK5 file is shown below.”), 19:35-20:7 (“4. Find all valid image events for the survey session (step 137). Repeat steps 1 and 2 above and look (step 138) for digital input word "249" in the *.MK5 record, then (step 140) find the valid *.CLI record as depicted in 2 above. If found, then find the corresponding valid TIFF Image file (step 142) as depicted in 1 above. Continue (step 144) to search for all image events and form valid associations until all are accounted for (step 146). Extract all necessary data from the *.MK5 and *.CLI records and write it to the PREPROC.AP3 file (step 148). Each valid image event will occupy one full record in the PREPROC.AP3 file. This is a binary file. All relevant data contained in the various AP3 input files are combined into a single file called PREPROC.AP3. **For each image event this file contains:** 1. GPS time 2. UTMNorthing of aircraft GPS antenna 3. UTM Easting of aircraft GPS antenna 4. Geoid height of the aircraft GPS antenna (altitude) **5. Gyro pitch** **6. Gyro roll** 7. Imager 12 pitch (not shown) 8. Imager 12 roll (not shown) 9. Heading (derived from magnetometer 24 or compass (not shown)) 10. Corresponding TIF image file from DIR 16 associated with the image event.

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Claim 3	Prior Art
	Heading is computed by extracting the magnetometer X, Y, and Z values from the datalogger record (step 139), applying the offsets entered in the preprocessing window in AP3 (see FIG. 6) to the magnetometer values, and combining Gyro Pitch and Gyro Roll and calculating heading (step 141). The algorithm that is used determines the attitude of the magnetometer (pitch, roll) and then calculates heading based upon the magnetometer values. The vector G which is true vertical is determined, and then the directional vector N which is magnetic north is calculated. The vector H which is vehicle heading relative to directional vector N is determined and entered as heading into the PREPROC.AP3 record (step 148).”), Fig.1, Fig.8c. 

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Claim 3	Prior Art
	 FIG. 8C POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with a GPS-detected locations indicative at least in part of a geo-location of each of a first and second associated image capturing device (in the combined Loewen-Fujimoto system, *see* cl.1.f) using Garrot's advantageous teachings of a gyroscope issuing to an image-capturing computer system a pitch signal, a roll signal, and a yaw signal (where those signals are

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Claim 3	Prior Art
	respectively indicative of a pitch, roll and yaw of an image-capturing devices at image-capturing events). POSITA would have recognized that implementing the combined Loewen-Fujimoto-Mostafa system with these additional gyroscope signals (as taught in Garrot) would advantageously permit POSITA to record more accurately the system's heading as it captured imagery in order to derive more accurate georeferenced imagery. Indeed, Garrot discloses using a gyroscope "yielding more accurate pitch and roll data" which can be "combined with the GPS data [to] provide[] real-time georeferencing information," which Garrot system uses "to produce high resolution, georeferenced imagery." EX1006, 6:14-47. Further, POSITA would have recognized that adding additional sensors, for example, a gyroscope along with, *e.g.*, an INS and compass would have been beneficial because doing so would add further precision to the georeferencing performed in the combined Loewen-Fujimoto-Mostafa system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[15]
[3.e]: a compass issuing to said image-capturing computer system heading data signals indicative of a heading of said first or second image-capturing device at	**Loewen in view of Garrot renders obvious this limitation.** **Loewen discloses issuing to said image-capturing computer system geo-location data signals indicative of a geo-location of said first or second image-capturing devices at said each image-capturing event** (*see* cl.1.c)**.** **Garrot discloses a compass** (*e.g.*, "compass") **issuing heading data signals indicative of a heading** (*e.g.*, "raw input files of… compass" from which "Heading" is "derived"") **of an image-capturing device at image-capturing events** (*e.g.*, "For each image event this file contains… Heading (derived from… compass)") to a computer. *See, e.g.*, EX1006, 12:20-37 ("This section discloses the processing flow used to produce the digital mosaicked images in accordance with the teachings of the present invention. The post

[15] *See* n.11.

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Claim 3	Prior Art
each said image-capturing event; and	flight data processing flow is depicted in FIG. 3. **The input data includes image constants and settings, digital imagery, GPS derived aircraft position, datalogger records consisting of aircraft attitude, heading and meteorological data, and optionally the raw input files of a digital magnetometer and compass (for backup purposes to derive heading).** Also, a GPS base station that is located at a surveyed site on the ground near the operating area produces a file of raw GPS measurements. This file is used to create differential corrections that are applied to the airborne GPS measurements to produce precision position solutions. Alternatively, differential corrections that are broadcast via the UHF radio to the airborne system can be logged and used in place of the base station file."), 13:34-51 ("GPS time stamps of each of the image strobe events is contained in the *.CT5 file where CT5 stands for serial port #5 of ACU 30 on the CT pin. **Every time an image is acquired, HPC time stamps it with a GPS time.** Also, serial data output from the Data Logger Unit (DLU) 28 is time tagged every time a $ character is encountered and stored in the *.CH5 file. The $ character appears as the first character in the DLU's ASCII serial output every time an image event or meteorological (MET) event occurs. **This file is later combined with the Data Logger Unit's serial data output to form a time stamped file which contains logger data and a GPS time for this event. A file containing optional magnetometer or compass data (*.CH3, and *.CH1 respectively) is stored and later processed in the same manner as the DLU's file *.CH5.** The ch suffix stands for "character" and the number that follows is the serial port ID known to HPC. All of these are binary files and are produced by the HPC software program."), 19:35-61 ("4. Find all valid image events for the survey session (step 137). Repeat steps 1 and 2 above and look (step 138) for digital input word "249" in the *.MK5 record, then (step 140) find the valid *.CLI record as depicted in 2 above. If found, then find the corresponding valid TIFF Image file (step 142) as depicted in 1 above. Continue (step 144) to search for all image events and form valid associations until all are accounted for (step 146). Extract all

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	necessary data from the *.MK5 and *.CLI records and write it to the PREPROC.AP3 file (step 148). Each valid image event will occupy one full record in the PREPROC.AP3 file. This is a binary file. All relevant data contained in the various AP3 input files are combined into a single file called PREPROC.AP3. **For each image event this file contains:** 1. GPS time 2. UTMNorthing of aircraft GPS antenna 3. UTM Easting of aircraft GPS antenna 4. Geoid height of the aircraft GPS antenna (altitude) 5. Gyro pitch 6. Gyro roll 7. Imager 12 pitch (not shown) 8. Imager 12 roll (not shown) **9. Heading (derived from magnetometer 24 or compass (not shown))** 10. Corresponding TIF image file from DIR 16 associated with the image event."). POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed image-capturing computer system for acquiring images in association with a GPS-detected locations indicative at least in part of a geo-location of each of a first and second associated image capturing device using Garrot's advantageous teachings of using a compass issuing to an image-capturing computer system heading data signals indicative of a heading (where that heading is also of an image-capturing device at image-capturing events). POSITA would have recognized that implementing the combined Loewen-Fujimoto-Mostafa-Garrot system with this additional compass input (as taught in Garrot) would have advantageously permitted POSITA to record more accurately the system's heading as it captured imagery in order to derive more accurate georeferenced imagery. Indeed, Garrot discloses using a compass to derive a heading which can be "combined with the GPS data [to] provide[] real-time georeferencing information," which Garrot's system uses "to produce high resolution, georeferenced imagery." EX1006, 6:14-47. Further, POSITA would have recognized that adding additional sensors, for example, a compass, along with an

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Claim 3	Prior Art
	INS and gyroscope, would have been beneficial because it would add further precision to the georeferencing performed in the combined Loewen-Fujimoto-Mostafa-Garrot system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[16]
[3.f]: an altimeter issuing to said image-capturing	**Loewen discloses this limitation.** **Loewen discloses an altimeter[17] issuing to said image-capturing computer system altitude data signals indicative of an altitude of said first or second image-capturing device[18] at each said**

[16] *See* n.11.

[17] Loewen expressly discloses that its system has both a laser altimeter and a GPS. *E.g.*, EX1004, 3:11-15 ("the tower detecting device is in the form of a laser altimeter… the system also contemplates the use of a GPS capability which cooperates in detecting the presence of a tower structure that is to be photographed"), Figs.8 (showing altimeter 74 and GPS 91), 9-10 (showing both "laser altimeter" and "GPS").

[18] POSITA would have understood Loewen discloses a geolocating device (altimeter) issuing altitude data signals indicative of an altitude of Loewen's image-capturing devices (including the first camera) at each image-capturing event. As Loewen expressly discloses, its "laser altimeter" "is capable of determining the height of the aircraft above the terrain," as well as "the major difference in height of the aircraft above a tower as compared to the height of the aircraft above the terrain" (*e.g.*, EX1004, 8:21-31), and the "laser altimeter… can be supported on the outer housing of the pod" (*e.g.*, EX1004, 8:15-16), which Loewen expressly discloses houses Loewen's image-capturing devices (EX1004, 5:62-64), and thus POSITA would have understood that the altitude determined by the laser altimeter to be indicative of the altitude of Loewen's aircraft or pod, and thus Loewen's image-capturing devices housed within the pod. Moreover, as Loewen expressly discloses, "the laser altimeter generates a signal in response to" sensing a "difference in height of the aircraft above a tower," and this "signal… is transmitted to the onboard computer establishing the fact that the aircraft has passed over a tower" such that an image should be captured (*e.g.*, EX1004, 8:31-

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Claim 3	Prior Art
computer system altitude data signals indicative of an altitude of said first or second image-capturing device at each said image-capturing event.	**image-capturing event** (*e.g.*, "the laser altimeter 74 will detect the passage of the aircraft over a tower structure and generate a signal"; "laser altimeter detects the major difference in height of the aircraft above a tower… [and] generates a signal in response to that difference which is transmitted to the onboard computer"; "laser survey module… has the computer recoding… continuous laser readings into a text file… [which] also contains the time stamp of the time when the laser altimeter located a transmission tower structure"; *see* cl.1.e)**.** *See, e.g.*, EX1004, Abstract ("A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. **The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter** or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees. The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay

34) , and thus POSITA would have further understood that the altitude data signals are indicative of an altitude of Loewen's image-capturing devices *at each image-capturing event*. *E.g.*, EX1004, 8:65-9:37 ("recording… continuous laser readings 91 into a text file…" "[t]his file also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower"), 10:14-16, 10:30-34, 11:1-14.

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Claim 3	Prior Art
	necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way."), 3:11-15 ("**In one embodiment, the tower detecting device is in the form of a laser altimeter. In an alternative embodiment, the system also contemplates the use of a GPS capability which cooperates in detecting the presence of a tower structure that is to be photographed.**"), 4:14-22 ("**In the embodiment which incorporates a laser altimeter, a signal is generated by the laser altimeter when it detects the presence of a tower. That signal is transmitted to the computer and the computer goes through the same type of calculation as described above to activate the still cameras at the exposure point and to reset the system for the next tower.** In this embodiment the computer determines the distance from the detected tower, which is the one to be photographed, to the exposure point for that tower."), 7:56-58 ("The trigger system 74 in the preferred embodiment is **a laser altimeter, a conventional and commercially available device**."), 8:15-34 ("The laser altimeter 74 can be supported on the outer housing of the pod or, as shown, at a convenient location on the aircraft fuselage 30 and connected in a conventional manner to the on board computer. That connection is illustrated schematically in FIG. 8 as being through the interface board 77 and directly to the computer, interface 83 and line 85 respectively. As is well known, the laser altimeter by projecting a laser beam 87 downwardly to the

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Claim 3	Prior Art
	terrain, is capable of determining the height of the aircraft above the terrain. It can be used to obtain data and artificially reproduce the topography of the terrain 12 along the right-of-way. In the application of this invention, it is used to detect the presence of a tower structure. When the beam 87 is interrupted by a tower structure, the laser altimeter detects the major difference in height of the aircraft above a tower 10 as compared to height of the aircraft above the terrain it had been sensing as the aircraft approached the tower. **The laser altimeter generates a signal in response to that difference which is transmitted to the onboard computer establishing the fact that the aircraft has passed over a tower.**"), 8:47-53 ("In general terms, the airborne inspection software is comprised of two setup stages, airborne capture and post processing. The airborne capture software can be considered as being made up of different operational modules that can be run either separately, or together as needed. **The modules include a video module, a laser survey module, a GPS camera trip module, and/or laser altimeter trip module.**"), 8:65-9:5 ("**A laser survey module (i.e., terrain mapping) has the computer recording all the GPS data strings as well as continuous laser readings 91 into a text file. This file also contains the time stamp of the time when the laser altimeter located a transmission tower structure, and in cooperation with the GPS, the longitude/latitude coordinates of each tower the same as was described above in connection with the video survey module.**"), 9:32-39 ("**The laser altimeter trip software module has the computer responding to the input from the laser altimeter signifying the laser altimeter has identified a tower structure.** The program then calculates, using the ground speed, to apply the proper time delay to trigger the still cameras at the desired exposure point. Again **the program records the time of the trip along with the geographic longitude/latitude coordinates of that tower location.**"),

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Claim 3	Prior Art
	9:65-10:3 ("**The laser altimeter beam 87 is directed downwardly, preferably at a right angle to the horizontal, and provides a continuous signal back to the computer of the distance in feet about the terrain.** This way, it is also possible to chart the topography of the terrain utilizing the data generated by the laser altimeter."), 10:4-13 ("More particularly and in accordance with the alternative embodiment of this invention and with reference to FIG. 10, **the laser altimeter 74 will detect the passage of the aircraft over a tower structure and generate a signal at that point. The signal is used to enable the system to embed the longitude/latitude coordinates of that tower location on the corresponding tower image, either the output from the video or the output from the still cameras, or both.** This provides a continuous identification of the geographical location of the towers in the power line."), 10:14-16 ("**The signal from the laser altimeter can also be used to enable and trigger the activation of the still camera shutters to produce the still images of the tower structure**."), 10:24-43 ("In one embodiment, and assuming the objective is to obtain both an inventory of the tower structures and an inspection of the towers and related equipment of a particular transmission line, an initial fly over is executed to provide basic data on the location of the towers. In that operation, the aircraft flies the transmission line with the video cameras operational. As the aircraft passes over a particular tower structure (sensed by the laser altimeter), the longitude/latitude coordinates are identified by the GPS and embedded in the imaging database in association with that particular tower structure. The system is also capable of assigning an inventory number to that tower structure. This is done for the entire transmission line being processed. This initial step would be utilized where the transmission line company does not already have established inventory database of the location of its towers. If the transmission line company has an established inventory database of its tower locations, by longitude/latitude, the initial fly over step is eliminated and the data on tower location is inputted from that database."),

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Claim 3	Prior Art
	11:1-14 ("In another embodiment, the physical detection of the presence of the tower structure is sensed and the system is enabled on that basis 105 (FIG. 10). That is, **the laser altimeter is continually sensing the profile of the terrain with its downwardly directed beam. As the aircraft passes over the tower structure it detects a major difference in distance from the aircraft to the top of the tower structure as compared to the distance from the aircraft to the terrain. That signal is transmitted to the computer system which then accomplishes a calculation 107 (FIG. 10) based on ground speed to enable and trigger the camera shutters 109 (FIG. 10)** at a preselected distance past the tower structure. The system is reset 111 for the next tower to be photographed."), Fig.9, Fig.10.

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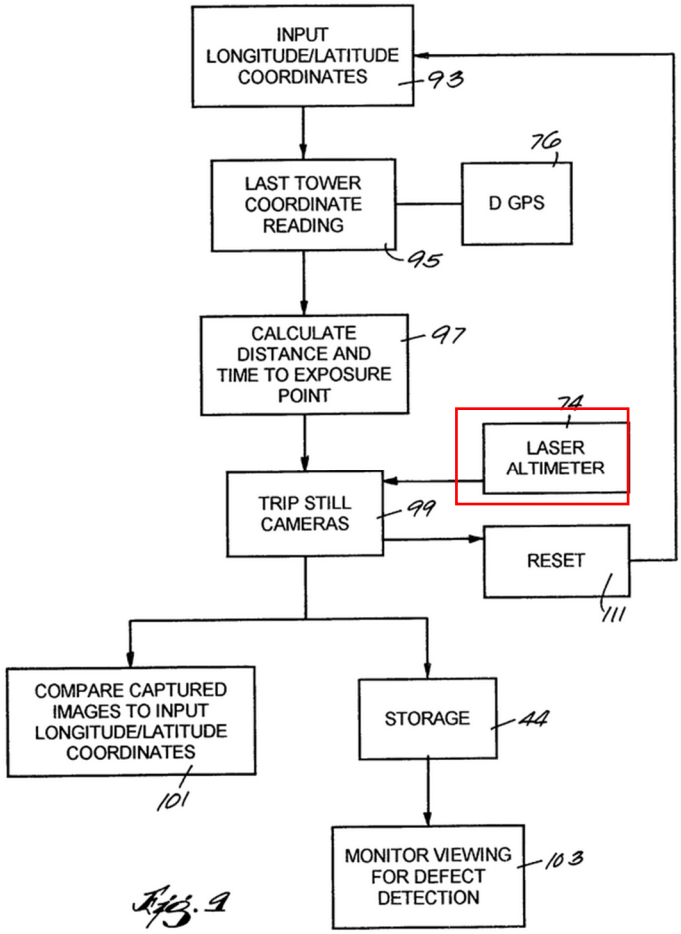
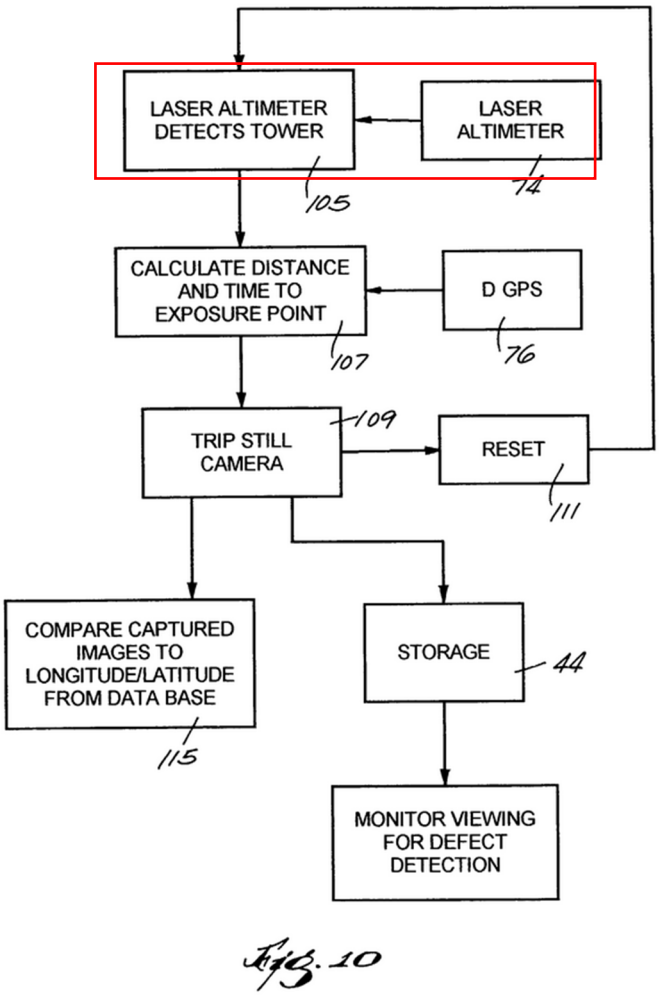
Claim 3	Prior Art
	

Fig. 9

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Claim 3	Prior Art
	 Fig. 10

Claim 2	Prior Art
[2]	**For the same reasons as discussed above as to claim 3, which is broader than claim 2 because it requires all of the recited "geo-locating device[s] and said at least one geo-locating signal[s]" whereas claim 2 requires only "at least one of" those recited elements, claim 2 is rendered obvious by Loewen in view of Fujimoto, Mostafa, and Garrot (Ground 2).**

Claim 4	Prior Art
[4]: The system for capturing images and geo-location data corresponding thereto of claim 1, wherein the first or second image-capturing device captures community level[19] oblique aerial images.	**Loewen in view of Fujimoto and Kain 1997 renders obvious claim 4.** **Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 1** (*see* cl.1), **wherein the first or second image-capturing devices captures oblique aerial images** (*see* cl.1.a)**.** **Kain 1997 discloses capturing community-level aerial images** (*e.g.*, "one foot per pixel image resolution"; "one foot image resolution")**.** *See, e.g.*, EX1008, 10:11-18 ("The disk storage unit 32 must have sufficient storage volume and a sufficient data transfer rate to store image data supplied by the frame grabber 28. Consider an airborne mission requiring **one foot per pixel image resolution** and an aircraft speed of l 00 knots at one frame per second. The 640 x 480 pixel single camera image frame provides a 65% overlap between images (480 pixel dimension along direction of motion). At one byte per pixel for each of the three cameras, a data storage rate of 0.92 megabyte per image, or 0.92 megabyte per second, is required. A conservative 1.5 megabyte per second storage rate is used as the nominal image storage transfer rate specification."). 12:13-22 ("In one operating mode, the end user makes arrangements to lease an aircraft and performs mission planning. Using the ground processing workstation 12, the user lays out the survey area to be imaged by selecting boundary points on a digital map. As indicated above, the ground processing workstation considers the endurance and turning properties of the aircraft to be used, the base airport

[19] The '657 patent states that "[f]or oblique community-level images, the ground sample distance varies from, for example, approximately one-foot per pixel in the foreground of the image to approximately two-feet per pixel in the mid-ground of the image, and to approximately four-feet per pixel in the background of the image." EX1001, 13:46-60.

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Claim 4	Prior Art
	location and camera parameters. This allows the automatic design of a three-dimensional trajectory for the aircraft, with image collection points selected for ideal coverage of the survey area. The trajectory, or multiple mission trajectories, is presented to the user for approval. Higher resolution requirements require more passes and possibly additional missions. A three-hour mission with two hours of the flight time collecting image data provides over 20,000 acres (32 square miles) of image coverage at a **one foot image resolution**."). POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed first image-capturing device that captures oblique aerial images using Kain's advantageous disclosure of capturing images including one foot per pixel image resolution (which POSITA would have understood is a community-level aerial image consistent with the '657 patent's explanation of that term) such that the first image-capture device in the resulting system captures community-level oblique aerial images in appropriate contexts, including for larger structures where small detail is of lesser concern, such as photographing the right-of-way (*i.e.*, the path defined by the tower structures and the transmission cables between towers) "to inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees and other plant growth or the like have encroached into the right-of-way and is presenting a potential interference with the transmission line," and to "provide aerial images of ground structures… roadways and the like." EX1004, 2:23-26, 5:37-41; *see also id.* at 2:19-21 ("Another objective of this invention is to provide a reliable and accurate record of the right-of-way of an electric transmission line, and to do so in **a cost-effective manner**."). Capturing community-level oblique aerial images of one-foot per pixel in the foreground of the image (in contexts, as noted above, where higher-resolution images are not required, such as capturing the right-of-way or roadways or identifying downed transmission towers following a severe storm), two-feet per pixel in the mid-ground, and four-feet per pixel in the

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Claim 4	Prior Art
	background[20] would have advantageously reduced storage requirements as compared to images captured at a higher-resolution, thereby allowing for a greater number of images to be captured and stored while still providing sufficient detail for various uses of such imagery, including, *e.g.*, to identify downed transmission towers following a severe storm (which would require less detailed imagery). Allowing for a greater number of images to be captured would have, *e.g.*, advantageously allowed for more views of the structures or areas of interest and/or more structures or areas of interest to be captured by the combined system in a single flight, thus beneficially increasing the coverage of the capture system. For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images of different resolution was well-known and conventional by varying well-known camera parameters (*e.g.*, field of view, sensor size) and distance from which an image is taken, and clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[21]

Claim 5	Prior Art
[5]: The system for capturing images and	**Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa renders obvious claim 5.**

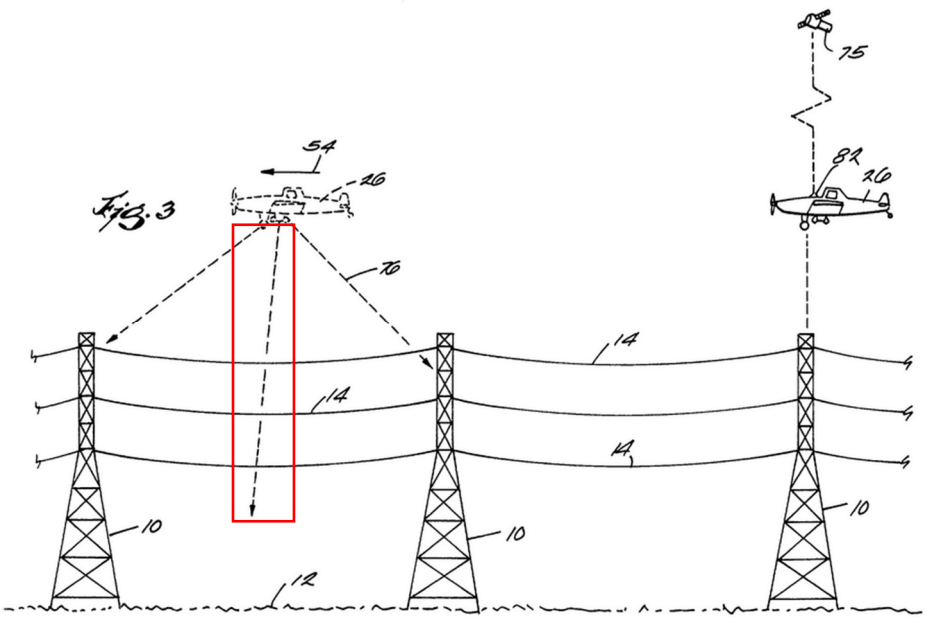
[20] As discussed (*see* n.1), POSITA would have understood Loewen to disclose using a 45 degree camera angle and a field of view at the upper end of the conventional and well-known range (as shown for cl.1.a), and that using this Loewen disclosure and Kain 1997's expressly-disclosed "one foot per pixel image resolution," oblique aerial images captured by Loewen's image-capturing devices would have had a ground sample distance of one foot per pixel in the foreground of the image, and decreasing resolutions (*e.g.*, more feet per pixel) in the mid-ground and background of such images, due to well-understood geometric principles.

[21] *See* n.11.

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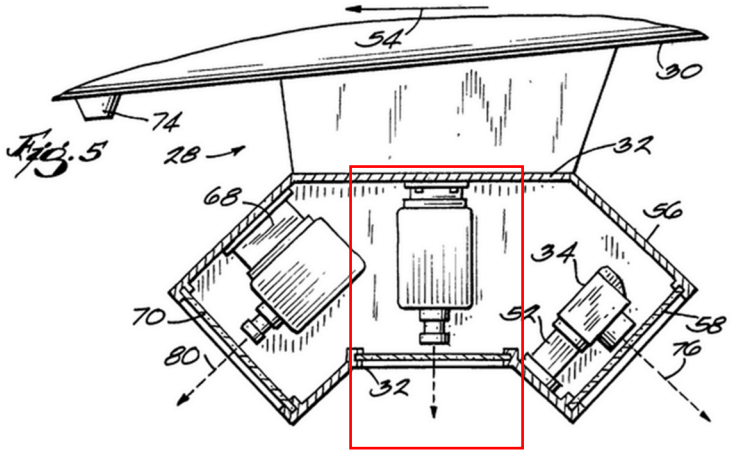
Claim 5	Prior Art
geo-location data corresponding thereto of claim 1, wherein the second image-capturing device captures orthogonal images at image-capturing events.	**Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 1** (*see* cl.1), **and Loewen discloses the second image-capturing device captures images at image-capturing events** (*see* cl.1.b)**. Loewen renders obvious the second image-capturing device capturing *orthogonal* images at image-capturing events.** POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement one of Loewen's disclosed multiple still cameras using Loewen's advantageous teachings of downward-facing video cameras such that in the resulting system Loewen's second image-capturing device captures *orthogonal* images at image-capturing events. Indeed, Loewen expressly discloses that the "number and arrangement of cameras can vary," EX1004, 5:62-6:2, and expressly discloses video cameras that point downward. *E.g.*, EX1004, 8:8-14 ("[T]he video camera 40 is arranged at 90 degrees, perpendicular to the horizontal, and takes pictures along a line 78 that is perpendicular to the line of flight."); 3:23-36 ("[O]ne video camera is arranged to take pictures along an exposure line which is at an angle of substantially 90 degrees to the horizontal and directed downwardly relative to the aircraft line of flight…."); 6:3-30 ("[A] second camera 40 looks down."); Figs.3, 5-6. Loewen further expressly discloses that its disclosed downward-pointing video cameras—which are used, *e.g.*, "for filming the right-of-way" to "inspect [its] integrity… [and] determine… if things such as trees and other plant growth or the like have encroached… and… present[] a potential interference"—advantageously produce still images. *E.g.*, EX1004, 8:54-57, 5:38-42, 6:3-7 ("The… video cameras used… operate in a progressive scan mode which produces… relatively clear still images that can be used in post process viewing."). Using a downward-facing still camera to take periodic orthogonal still photographs, rather than a downward-facing video camera (which is replaced by the second image-capturing device (still camera) in this combination), would have reduced the memory used by the system by replacing memory-intensive video

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Claim 5	Prior Art
	recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Using one of Loewen's still cameras rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." EX1004, 2:19-21. This would have advantageously enabled the combined system to provide more detail of captured structures, the right-of-way, or other capture objectives at a lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[22] 

[22] *See* n.11.

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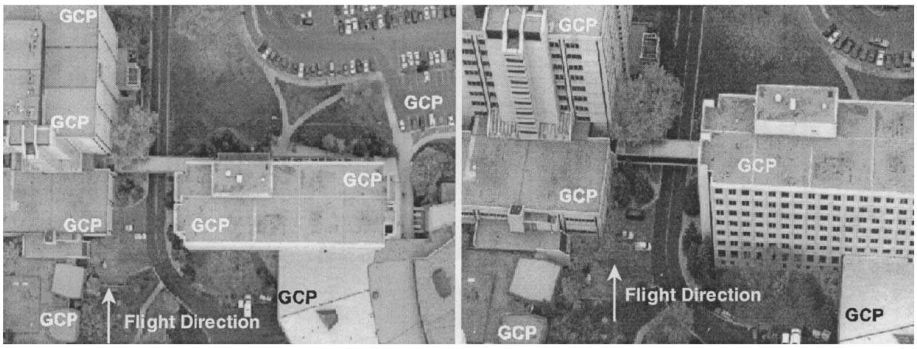
Claim 5	Prior Art
	 **Loewen in view of Mostafa also renders this limitation obvious based on the same Loewen disclosures immediately above in addition to the Mostafa disclosures below, including in particular a "digital camera[]… which is nadir" (for which I rely on Mostafa for Ground 4).** **Mostafa discloses an image-capturing device capturing orthogonal images at image-capturing events** (*e.g.*, "digital camera[]… which is nadir" and captures "nadir digital image[s]")**.**[23] *See, e.g.*, EX1007, Abstract ("In this paper, the development and testing of an airborne fully digital multi-sensor system for digital mapping data acquisition is presented. **The system acquires two streams of data, namely**, navigation (georeferencing) data and **imaging data.** The navigation data are obtained by integrating an accurate strapdown inertial navigation system with a differential GPS system (DGPS). The imaging data are acquired by two low-cost digital cameras, configured in such a way so as to reduce their geometric limitations. **The two cameras capture strips of overlapping nadir and oblique images.** The GPS/INS-derived trajectory contains the full translational and rotational motion of the

[23] POSITA would have understood that "nadir" means pointing directly down, and thus would have understood that Mostafa discloses capturing "orthogonal" images.

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Claim 5	Prior Art
	carrier aircraft. Thus, image exterior orientation information is extracted from the trajectory, during post-processing. This approach eliminates the need for ground control (GCP) when computing 3D positions of objects that appear in the field of view of the system imaging component. Two approaches for calibrating the system are presented, namely, terrestrial calibration and in-flight calibration. Test flights were conducted over the campus of The University of Calgary. Testing the system showed that best ground point positioning accuracy at 1:12,000 average image scale is 0.2 m (RMS) in easting and northing and 0.3 m (RMS) in height. Preliminary results indicate that major applications of such a system in the future are in the field of digital mapping, at scales of 1:5000 and smaller, and in the generation of digital elevation models for engineering applications."), 4, ("Therefore, the imaging component of the system has been designed to include ***two low-cost 1.5 X 1 K digital cameras, one of which is nadir***, and the other is oblique. This allows for ***covering the same ground scene with a nadir and an oblique image*** that, when simultaneously processed, provides a wider intersection angle and thus better height accuracy."), 6 ("Fig. 4 shows the radial lens distortion profiles estimated during the pre- (solid lines) and post-flight (dashed lines) calibration for the ***nadir camera*** and the oblique camera. The digital camera calibration results agree with a previous work reported… especially for the ***nadir camera*** typically equipped with a 28-mm lens"), 9 ("The GPS/INS interpolated position and attitude angles at each exposure station were used together with the imagery to analyse the system performance when using ***nadir plus oblique images***. After preprocessing the GPS/INS data to compensate for the position and orientation offsets between the navigation and imaging sensors, the compensated position and attitude parameters were used as observable exterior orientation parameters (in M-frame) together with their standard

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Claim 5	Prior Art
	deviations and the image point measurements from the commercial software package PCI OrthoEngine."), 10 ("The analysis was done as follows: using a stereopair of ***nadir images***; using a stereopair of ***nadir images*** plus an extra oblique image; using a ***strip of five nadir images***; using a strip of ***five nadir images*** plus extra oblique images as available; using a block of 3 X 3 ***nadir images***; and using a block of 3 X ***3 nadir images*** and oblique images in addition to cross strips in both directions."), Fig.6:  Fig. 6. A nadir digital image (left) and an oblique digital image (right), October 1998 flights. POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement one of the multiple still cameras of the combined Loewen-Fujimoto aerial image-capturing system, which captures oblique aerial images using "still, digital cameras," and captures orthogonal images using, *e.g.*, a video camera "arranged at 90 degrees" for, *e.g.*, "filming the right-of-way" (EX1004, 2:30-36, 5:38-42, 5:62-6:2 ("number and arrangement of cameras can vary"), 8:8-14, 8:54-57) using Mostafa's advantageous disclosure of a downward-facing (*e.g.*, "nadir," EX1007, Abstract) still camera instead of Loewen's downward-facing video camera. As POSITA would have understood and immediately recognized, using a downward-facing still camera, as expressly disclosed by Mostafa (*e.g.*, EX1007, Abstract), to take periodic orthogonal still photographs, rather than a downward-facing video camera (which is replaced by the second image-capturing

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Claim 5	Prior Art
	device (still camera) in this combination), would have reduced the memory used by the system by replacing memory-intensive *video* recordings with a series of discrete *still* photographs separated in time, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video), beneficially increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Using one of Loewen's still cameras rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004, 2:19-21. Moreover, Mostafa expressly discloses that the use of a nadir digital still camera "allows for covering the same ground scene with a nadir and an oblique image that, when simultaneously processed, provides a wider intersection angle and thus better height accuracy." EX1007, 4. This would have advantageously enabled the combined system to provide higher accuracy (including as to the height of any transmission towers to ascertain whether such towers are leaning or their foundations have settled), more detailed images of captured structures, the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[24]

Claim 14	Prior Art
[14]: The system for capturing images and geo-location data corresponding	**Loewen in view of Fujimoto renders obvious claim 14.** **Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 1** (*see* cl.1)**, and Loewen further discloses a platform carrying the first and second image capturing**

[24] *See* n.11.

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Claim 14	Prior Art
thereto of claim 1, further comprising a platform[25] carrying the first and second image-capturing devices through a controlled flight.	**devices** (*see* cl.1.a., cl.1.b) **through a controlled flight** (*e.g.*, "fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images"; "fixed wing aircraft and an arrangement of at least one still camera"; "fixed wing aircraft… pod… fixed to the underside… of the aircraft fuselage" that "includes a number of cameras"; *see* cl.1.a, cl.1.b)**.** *See, e.g.*, EX1004, Abstract ("A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. **The system uses a fixed wing aircraft and an arrangement of at least one still camera**, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. **The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet).** The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees. The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The

[25] The '657 patent explains that "platform" includes an "airplane." EX1001, 4:4-16 ("Platform 20, such as, for example, an airplane… carries image-capturing system 30 over a predefined area of and at one or more predetermined altitudes above surface 31, such as, for example, the earth's surface or any other surface of interest."). To the extent it is argued that the "platform" requires a "pod" or other structure affixed to an aircraft, Loewen expressly discloses this. *E.g.*, EX1004, 5:43-66, Figs.2, 5-6.

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Claim 14	Prior Art
	central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way."), 2:30-38 ("**For the achievement of these and other objects, this invention proposes a system utilizing a fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images of the electric transmission line tower structures and equipment attached to those towers.** Although this discussion will refer to the use of plural cameras, it will be appreciated that this invention contemplates the use of one or more still cameras."), 2:39-49 ("In accordance with this invention, the still cameras take pictures of the towers from an exposure point between two adjacent towers and along an exposure line that is at a shallow angle to the horizontal. **The horizontal is defined in terms of the desired line of flight of the aircraft; the line of flight being generally parallel to the terrain over which the transmission lines are strung and over which the aircraft is flying.** The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees."), 2:50-3:2 ("More specifically, **the aircraft is flown along the transmission line at a low altitude, preferably 60–100 feet above the tops of the tower structures. The aircraft speed**

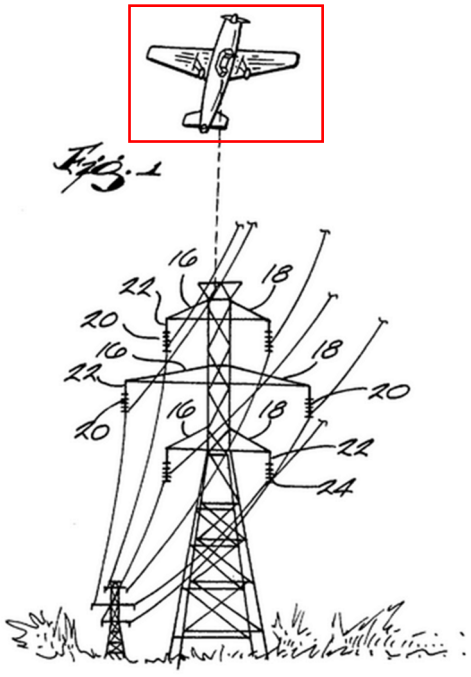
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Claim 14	Prior Art
	is in the range of 80–100 miles per hour. That altitude and speed allow the use of advantagous exposure parameters (shutter speed, lens opening and resulting depth of field) for the cameras such as to result in capturing the high quality, still, high resolution images. Also, at that speed, sufficient time is available for the transfer of imaging data from the cameras to storage and for resetting the cameras to capture images of the next, upcoming tower. Placing the exposure point for the still cameras between the adjacent towers and at the shallow angle to the horizontal produces high-resolution images; flying at the above-described altitude contributes to the high-resolution imagery. **The exposure point, angle of the line on which the still cameras take the pictures, and the altitude of the aircraft are all factors in insuring that images of at least the upper portion of the tower carrying the transmission lines, the electric insulators, and hardware are properly framed in the picture.**"), 4:31-34 ("The data generated by the still cameras is transmitted, in digital form, to a data storage system on board the aircraft where it is stored for later retrieval and post processing as desired."), 4:35-40 ("**The system can also incorporate displays in the aircraft cockpit to allow the pilot to monitor the line of flight of the aircraft relative to the right-of-way and/or to monitor the state of operation of the image capture portion of the system.** In addition, a flash assembly can be used to enhance the photos being taken."), 4:48-50 ("FIG. 1 is a generally schematic, perspective view of an aircraft flying over a transmission line in accordance with this invention;"), 4:51-52 ("FIG. 2 is a generally schematic view of an aircraft incorporating the system of this invention;"),

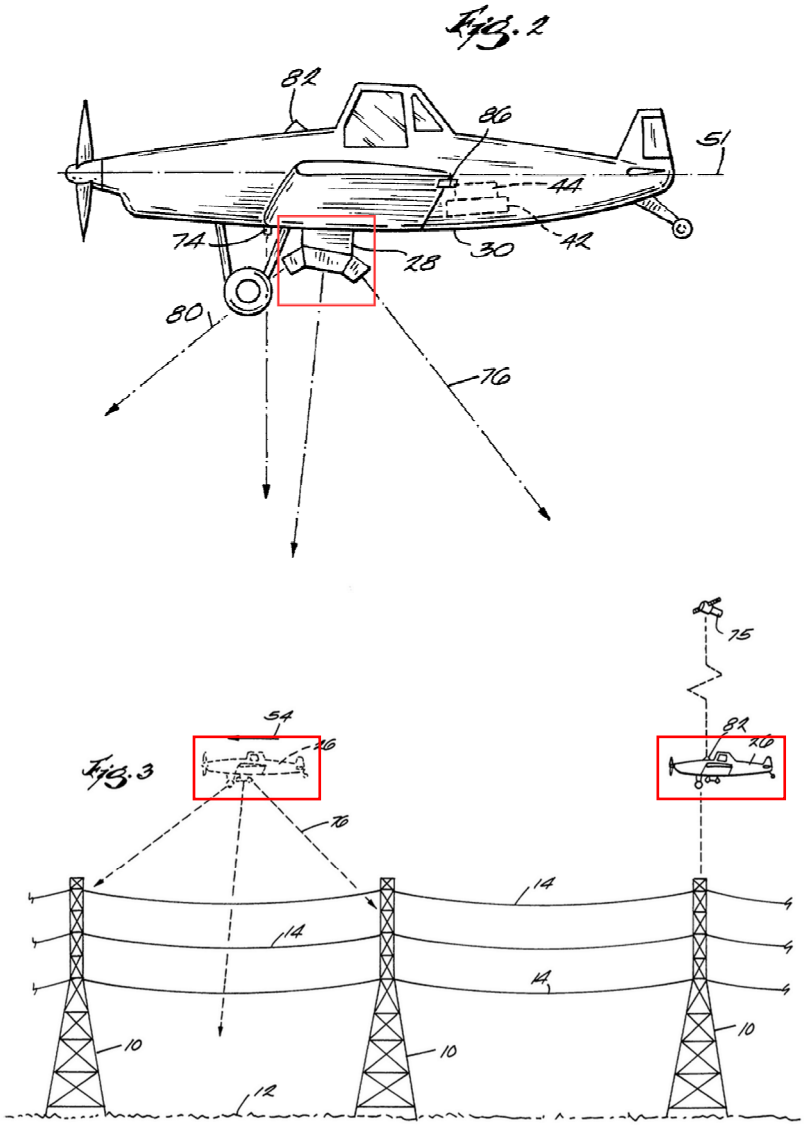
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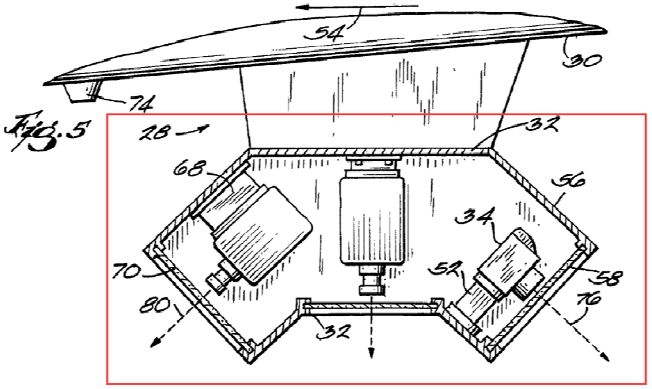
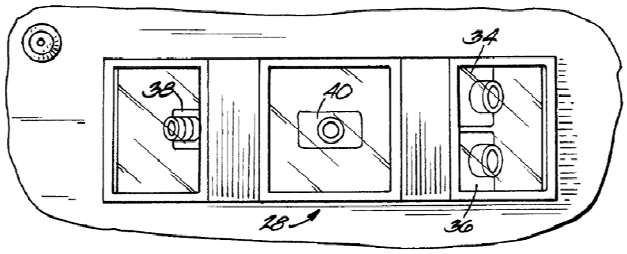
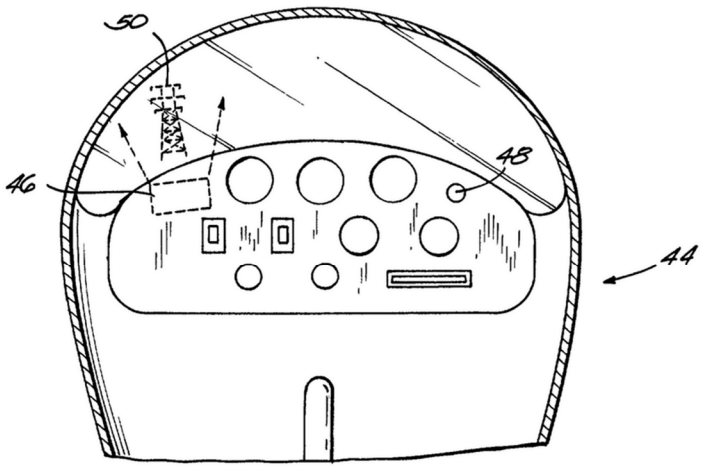
Claim 14	Prior Art
	4:53-54 ("FIG. 3 is a generally schematic, side view of the aircraft of FIG. 2 flying over the transmission line;"), 4:58-60 ("FIG. 5 is partial view of the aircraft fuselage and the pod attached to the fuselage with the interior of pod exposed to show the cameras;"), 4:61 ("FIG. 6 is a bottom view of the pod and cameras;"), 4:62-64 ("FIG. 7 is a view of the instrument panel and windshield of the aircraft as viewed from the interior of the cockpit of the aircraft;"), 5:43-54 ("To that end and in accordance with this invention, **a fixed wing aircraft 26 is equipped with a data collection system**. **In the preferred embodiment of this invention, the fixed wing aircraft is a Piper Pawnee of the type commonly used in crop dusting applications.** The data collection system includes **a pod 28 fixed to the underside 31 of the aircraft fuselage** generally in the area which would coincide with the center of gravity of the aircraft. Locating the pod in the area of the center of gravity minimizes the error in the data collection system that can occur due to movement of the aircraft from the preferred line of flight, as will be described and/or become evident from the description to follow."), 5:55-61 ("**The use of the Piper Pawnee is desirable, as it is capable of consistent and reliable flight at the low altitude and low speeds of the system of this invention.** For example, the aircraft can fly continuously over the tower structures at a ground speed and altitude preferred in this invention, namely approximately 80–100 miles per hour and an altitude of 80–100 feet above the tops of the tower structures."), 5:61-64 ("The **data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures**."),

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Claim 14	Prior Art
	6:31-40 ("The **digital still cameras are supported in the pod** by a bracket system 52 with the cameras facing rearward, that is rearward in the reference to the direction or line of flight of the aircraft. Arrow 54 in FIG. 5 illustrates the direction of flight. The **cameras look through a short tunnel section 56 of the pod housing**. The end of the tunnel section is preferable covered by glass panel 58 to prevent intrusion of moisture, dirt, bugs and the like into the pod and impingement on the camera and/or camera lenses."), cl.31 ("an aircraft, a data collection pod connected to the underside of said aircraft, said data collection pod including: a housing attached to said fuselage, a digital still camera supported in said housing"), Fig.1, Fig.2, Fig.3, Figs.5-7: 

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Claim 14	Prior Art
	

Claim 14	Prior Art
	 Fig. 5  Fig. 6  Fig. 7

Claim 19	Prior Art
[19]: The system for capturing images and geo-location data corresponding	**Loewen in view of Fujimoto renders obvious claim 19.** **Additionally, Loewen in view of Fujimoto and Mostafa renders obvious claim 19.**

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Claim 19	Prior Art
thereto of claim 14, wherein the first and second image-capturing devices have different angles of declination.	**Loewen in view of Fujimoto renders obvious the system for capturing images and geo-location data corresponding thereto of claim 14** (*see* cl.14)**, and Loewen further discloses first and second image-capturing devices** (*see* cl.1.a, cl.1.b) **each directed at a 30-60 degree angle to the line of flight** (*e.g.*, "still cameras are arranged to take pictures… at an angle to the line of flight… in the range of 30–60 degrees"; "still photographs are taken along a line which is 30–60 degrees to the horizontal"; *see* cl.1.a-1.b, cl.5)**. As discussed below, Loewen renders obvious or Loewen in view of Mostafa renders obvious those image-capturing devices having different angles of declination.** *See, e.g.*, EX1004, Abstract ("The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees."), 2:46-49, ("The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees."), 7:62-67 ("Using the line of flight of the aircraft 54 as a base of reference, a reference base which corresponds generally with the longitudinal axis of the aircraft, the still cameras are arranged to take pictures along a line 76 at an angle to the line of flight. That angle is in the range of 30–60 degrees, preferably 45."), 11:45-47 ("The still photographs are taken along a line which is 30–60 degrees to the horizontal, preferably 45 degrees."). Loewen renders obvious this limitation. As discussed above (*see* cl.1.a, cl.1.b), Loewen discloses that each of its first image-capturing device and second image-capturing device is pointing backwards ("rearwardly") and "directed downwardly at an angle to the line of flight, 30-60 degrees." EX1004,

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Claim 19	Prior Art
	Abstract. POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosure of first and second image-capturing devices directed downwardly at an angle of declination of 30-60 degrees using different angles of declination for the first and second image-capturing devices. POSITA would have recognized that using different angles of declination for the first and second image-capturing devices would advantageously improve the variety of imagery data and detail produced with fewer surveys, allowing users to extract additional information (from employing a variety of perspectives) while balancing imagery survey costs. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[26] Alternatively, Loewen renders obvious this limitation, at minimum, because Loewen renders obvious the system described in claim 5, *i.e.*, the system of Loewen having the first image-capturing device directed in an oblique angle and the second image-capturing device directed in an orthogonal angle. POSITA would understand that this arrangement has first and second image-capturing devices having different angles of declination, because the angle of declination of the first image-capturing device is 30-60 degrees and the angle of declination of the second-image capturing device is 90 degrees. As explained above (*see* cl.5), POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement one of Loewen's disclosed multiple still cameras using Loewen's advantageous teachings of downward facing cameras such that in the resulting system Loewen's second image-capturing device captures orthogonal images at image-capturing events. Indeed, Loewen expressly discloses that the "number and arrangement of cameras can vary," EX1004, 5:62-6:2, and expressly discloses cameras that point downward. *E.g.*, EX1004, 8:8-14 ("[T]he video camera

[26] *See* n.11.

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Claim 19	Prior Art
	40 is arranged at 90 degrees, perpendicular to the horizontal, and takes pictures along a line 78 that is perpendicular to the line of flight."); 3:23-36 ("[O]ne video camera is arranged to take pictures along an exposure line which is at an angle of substantially 90 degrees to the horizontal and directed downwardly relative to the aircraft line of flight…."); 6:3-30 ("[A] second camera 40 looks down."); Figs.3, 5-6. Loewen further expressly discloses that its disclosed downward-pointing video cameras—which are used, *e.g.*, "for filming the right-of-way" to "inspect [its] integrity… [and] determine… if things such as trees and other plant growth or the like have encroached… and… present[] a potential interference"—advantageously produce still images. *E.g.*, EX1004, 8:54-57, 5:38-42, 6:3-7 ("The… video cameras used… operate in a progressive scan mode which produces… relatively clear still images that can be used in post process viewing."). Using a downward-facing still camera to take periodic orthogonal still photographs, rather than a downward-facing video camera (which is replaced by the second image-capturing device (still camera) in this combination), would have reduced the memory used by the system by replacing memory-intensive video recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video at similar resolutions, thus permitting the still camera to capture even higher resolution imagery), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Using one of Loewen's still cameras rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004, 2:19-21. This would have advantageously enabled the combined system to provide more detail of captured structures, the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to

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Claim 19	Prior Art
	POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[27] Alternatively, for the same reasons as discussed immediately above and with respect to claim 5, Loewen in view of Mostafa renders obvious this limitation, at minimum, because Loewen-Fujimoto-Mostafa renders obvious the system described in claim 5, *i.e.*, the multiple still cameras of the Loewen-Fujimoto system using Mostafa's advantageous disclosure of a down-ward facing (*e.g.*, "nadir," EX1007, Abstract) still camera instead of Loewen's downward-facing video camera. *See* cl.5. As discussed immediately above and with respect to cl.5, for POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[28]

Claim 20	Prior Art
[20]: The system for capturing images and geo-location data corresponding thereto of claim 14, further comprising a third image-capturing device, wherein the first and	**Loewen in view of Fujimoto renders obvious claim 20.** **Alternatively, Loewen in view of Fujimoto and Mostafa renders obvious claim 20.** **Loewen discloses the system for capturing images and geo-location data corresponding thereto of claim 14** (*e.g.*, cl.14)**, further comprising a third image-capturing device**[29] (*e.g.*, "still camera"; "one or more still cameras"; "number and arrangement of the cameras can vary")**, wherein the first** (*e.g.*, cl.1.a) **and second image-capturing devices** (*e.g.*, second "still camera"; "still camera 36" Fig.6); *see* cl.1.b) **are capturing oblique aerial images** (*e.g.*, "The still camera points rearwardly relative to the line of flight of the aircraft and

[27] *See* n.11.

[28] *See* n.11.

[29] *See* n.4.

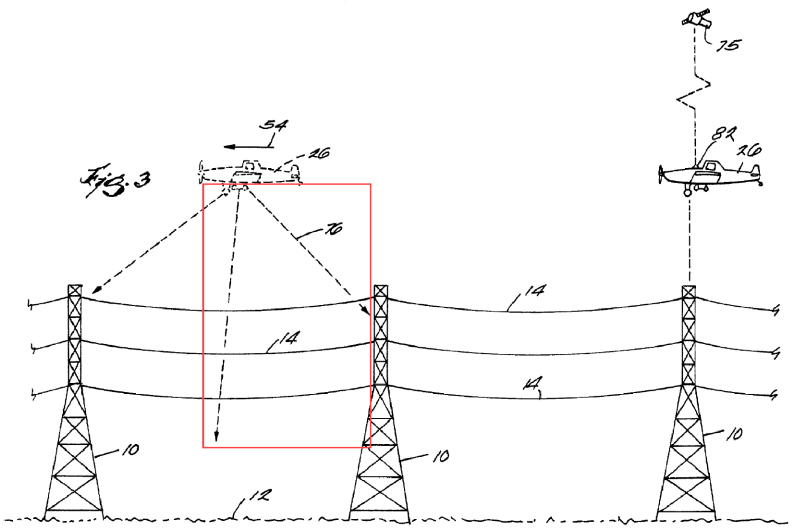
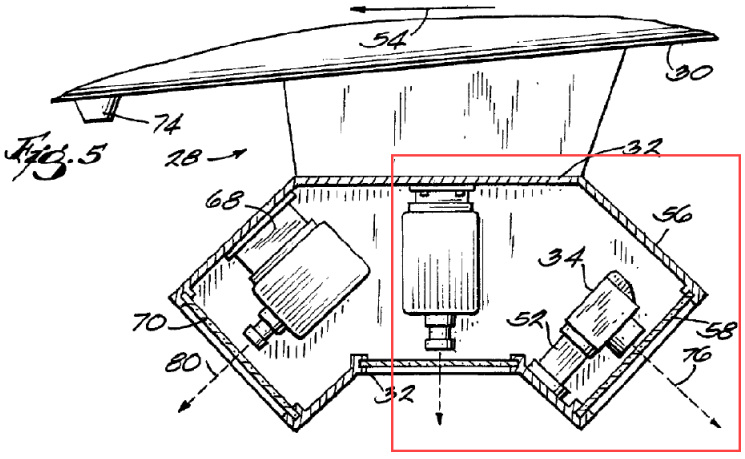
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Claim 20	Prior Art
second image-capturing devices are capturing oblique aerial images and the third image-capturing device is capturing orthogonal aerial images.	take a picture… at an angle to the line of flight, 30–60 degrees and preferably 45 degrees”)**.** *See, e.g.*, EX1004, Abstract (“A system and apparatus for acquiring images of electric transmission line tower structures, equipment attached to said tower structures, and transmission lines suspended from said towers. The system uses a fixed wing aircraft and an arrangement of at least one still camera, means for detecting a tower structure, a data storage unit, and a central processing unit containing operational software. The central processing unit is connected to the camera, the means for detecting a tower structure, and the storage unit. The detection means is a laser altimeter or a combination of preset longitude/latitude coordinates for tower locations and a GPS unit which supplies continuous longitude/latitude coordinates for the aircraft location for comparison to those preset coordinates. The aircraft is flown along the transmission line at a predetermined altitude above the tops of said towers (60–100 feet). **The still camera points rearwardly relative to the line of flight of the aircraft and take a picture from between two adjacent towers and along an exposure line directed downwardly at an angle to the line of flight, 30–60 degrees and preferably 45 degrees.** The detecting means transmits a signal to the central processing indicative of the presence of a tower to be photographed. The central processing unit calculates the time delay necessary for said aircraft to fly past the tower to a predetermined exposure point located between the tower to be photographed and the next tower in said transmission line after the tower to be photographed. The still camera is activated at the exposure point to acquire an image of the tower structure. The data corresponding to the acquired image is transmitted to a data storage unit for later retrieval and examination to identify defects in the tower or the equipment or transmission lines suspended form the tower. The system is reset to continue acquiring images along the transmission lines. The system is also provided with a video capability to film the towers and transmission lines and the line right-of-way.”),

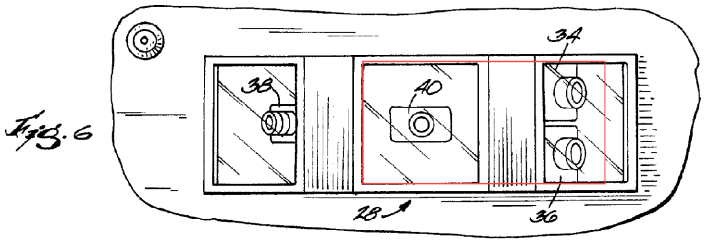
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Claim 20	Prior Art
	2:30-38 ("For the achievement of these and other objects, this invention proposes a system utilizing a fixed wing aircraft which is flown in close proximity to the towers to enable an arrangement of still, digital cameras on the aircraft to capture high resolution images of the electric transmission line tower structures and equipment attached to those towers. Although this discussion will refer to the use of plural cameras, it will be appreciated that this invention contemplates the use of **one or more still cameras.**"), 2:39-49 ("In accordance with this invention, the still cameras take pictures of the towers from an exposure point between two adjacent towers and along an exposure line that is at a shallow angle to the horizontal. The horizontal is defined in terms of the desired line of flight of the aircraft; the line of flight being generally parallel to the terrain over which the transmission lines are strung and over which the aircraft is flying. **The still cameras point rearwardly relative to the line of flight and are arranged to take pictures along an exposure line that is at an angle of substantially 30–60 degrees to the horizontal, preferably 45 degrees.**"), 5:62-6:2 ("The data collection system pod includes a number of cameras supported in a protective outer housing 32 to collect images of the tower structures, the equipment supported on the tower structures and the transmission cables themselves, as well as images of the right-of-way. **The number and arrangement of the cameras can vary**, but preferably two digital still cameras 34 and 36 and two digital video cameras 38 and 40 are mounted within the housing."), 7:62-8:7 ("Using the line of flight of the aircraft 54 as a base of reference, a reference base which corresponds generally with the longitudinal axis of the aircraft, **the still cameras are arranged to take pictures along a line 76 at an angle to the line of flight. That angle is in the range of 30–60 degrees, preferably 45 degrees.** Since the aircraft will make its fly over in a horizontal flight altitude, this direction or line of flight will be referred to as horizontal and the angle of the camera

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Claim 20	Prior Art
	orientation will be referred to as being at an angle to the horizontal. It being noted, in that altitude the axis 51 of the aircraft is normally horizontal and the camera exposure angles could also be described in reference to the longitudinal axis of the aircraft.”), Fig.3, Figs.5-6.  

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Claim 20	Prior Art
	 **Loewen renders obvious the third image-capturing device[30] capturing orthogonal aerial images** (*see* cl.5)**. Thus, Loewen renders obvious this limitation.** POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed two rear-facing still cameras (which capture oblique aerial images at image-capturing events) (which Loewen expressly discloses would have advantageously allowed one camera to be oriented to capture landscape-type images and the other camera to capture portrait photographs (*see* EX1004 (Loewen), 11:36-40)) using Loewen's advantageous teachings of an additional downward-facing camera (in place of the video camera) such that in the resulting system Loewen's first and second image-capturing devices capture oblique aerial images at image-capturing events and a third image-capturing device (*e.g.*, still camera) captures orthogonal images at image-capturing events. Indeed, Loewen expressly discloses using "one or more" still cameras and that the "number and arrangement of cameras can vary," EX1004, 2:36-38, 5:62-6:2, and expressly discloses cameras that point downward. *E.g.*, EX1004, 8:8-14 ("[T]he video camera 40 is arranged at 90 degrees, perpendicular to the horizontal, and takes pictures along a line 78 that is perpendicular to the line of flight."); 3:23-36 ("[O]ne video camera is arranged to take pictures

[30] As discussed with respect to cl.5, Loewen renders obvious a "still camera" (*i.e.*, image-capturing device") capturing orthogonal images at image-capturing events. I rely on those same disclosures for the "capturing orthogonal aerial images" limitation of cl.20, and the disclosures discussed immediately above for the "third image-capturing device."

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Claim 20	Prior Art
	along an exposure line which is at an angle of substantially 90 degrees to the horizontal and directed downwardly relative to the aircraft line of flight…."); 6:3-30 ("[A] second camera 40 looks down."); Figs.3, 5-6. Loewen further expressly discloses that its disclosed downward-pointing video cameras—which are used, e.g., "for filming the right-of-way" to "inspect [its] integrity… [and] determine… if things such as trees and other plant growth or the like have encroached… and… present[] a potential interference"—advantageously produce still images. E.g., EX1004, 8:54-57, 5:38-42, 6:3-7 ("The… video cameras used… operate in a progressive scan mode which produces… relatively clear still images that can be used in post process viewing."). Using a downward-facing still camera to take periodic orthogonal still photographs (triggered by, *e.g.*, Loewen's laser altimeter detecting an object in the right-of-way and sending a signal to Loewen's onboard computer, which in turn triggers Loewen's image-capturing devices, or configured to capture still images at set intervals rather than continuous, memory-intensive video recordings), rather than a downward-facing video camera, would have reduced the memory used by the system by replacing memory-intensive video recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video at similar resolutions, thus permitting the still camera to capture even higher resolution imagery), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Using a still camera rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004, 2:19-21. This would have advantageously enabled the combined system to provide more detail of captured structures, the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably

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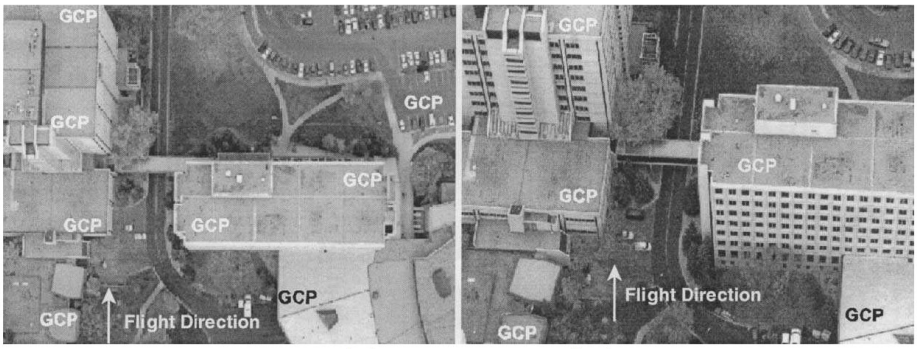
Claim 20	Prior Art
	yielding the expected functionality with a reasonable expectation of success.[31] **Loewen in view of Mostafa also renders this limitation obvious based on the same Loewen disclosures above in addition to the Mostafa disclosures below, including in particular a "digital camera[]… which is nadir" (for which I rely on Mostafa for Ground 4).** **Mostafa discloses an image-capturing device capturing orthogonal images** (*e.g.*, "digital camera[]… which is nadir" and captures "nadir digital image[s]")**.** *See, e.g.*, EX1007, Abstract ("In this paper, the development and testing of an airborne fully digital multi-sensor system for digital mapping data acquisition is presented. **The system acquires two streams of data, namely**, navigation (georeferencing) data and **imaging data.** The navigation data are obtained by integrating an accurate strapdown inertial navigation system with a differential GPS system (DGPS). The imaging data are acquired by two low-cost digital cameras, configured in such a way so as to reduce their geometric limitations. **The two cameras capture strips of overlapping nadir** and oblique **images.** The GPS/INS-derived trajectory contains the full translational and rotational motion of the carrier aircraft. Thus, image exterior orientation information is extracted from the trajectory, during post-processing. This approach eliminates the need for ground control (GCP) when computing 3D positions of objects that appear in the field of view of the system imaging component. Two approaches for calibrating the system are presented, namely, terrestrial calibration and in-flight calibration. Test flights were conducted over the campus of The University of Calgary. Testing the system showed that best ground point positioning accuracy at 1:12,000 average image scale is 0.2 m (RMS) in easting and northing and 0.3 m (RMS) in height. Preliminary results indicate that major applications of such a system in the

[31] *See* n.11.

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Claim 20	Prior Art
	future are in the field of digital mapping, at scales of 1:5000 and smaller, and in the generation of digital elevation models for engineering applications.”), 4, (“Therefore, the imaging component of the system has been designed to include ***two low-cost 1.5 X 1 K digital cameras, one of which is nadir***, and the other is oblique. This allows for ***covering the same ground scene with a nadir*** and an oblique ***image*** that, when simultaneously processed, provides a wider intersection angle and thus better height accuracy.”), 6 (“Fig. 4 shows the radial lens distortion profiles estimated during the pre- (solid lines) and post-flight (dashed lines) calibration for the ***nadir camera*** and the oblique camera. The digital camera calibration results agree with a previous work reported… especially for the ***nadir camera*** typically equipped with a 28-mm lens”), 9 (“The GPS/INS interpolated position and attitude angles at each exposure station were used together with the imagery to analyse the system performance when using ***nadir*** plus oblique ***images***. After preprocessing the GPS/INS data to compensate for the position and orientation offsets between the navigation and imaging sensors, the compensated position and attitude parameters were used as observable exterior orientation parameters (in M-frame) together with their standard deviations and the image point measurements from the commercial software package PCI OrthoEngine.”), 10 (“The analysis was done as follows: using a stereopair of ***nadir images***; using a stereopair of ***nadir images*** plus an extra oblique image; using a ***strip of five nadir images***; using a strip of ***five nadir images*** plus extra oblique images as available; using a block of 3 X 3 ***nadir images***; and using a block of 3 X ***3 nadir images*** and oblique images in addition to cross strips in both directions.”), Fig.6:

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Claim 20	Prior Art
	 Fig. 6. A nadir digital image (left) and an oblique digital image (right), October 1998 flights. POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement the combined Loewen-Fujimoto aerial image-capturing system, relies on Loewen's disclosures of capturing oblique aerial images using, *e.g.*, "still, digital cameras," and capture of orthogonal images using, *e.g.*, a video camera "arranged at 90 degrees" for, *e.g.*, "filming the right-of-way" (EX1004, 2:30-36, 5:38-42, 5:62-6:2 ("number and arrangement of cameras can vary"), 8:8-14, 8:54-57) using Mostafa's advantageous disclosure of a downward-facing still camera (*e.g.*, "nadir," EX1007, Abstract) in place of Loewen's downward-facing video camera. Using a downward-facing still camera, as expressly disclosed by Mostafa (*e.g.*, EX1007, Abstract), to take periodic orthogonal still photographs, rather than a downward-facing video camera (triggered by, *e.g.*, Loewen's laser altimeter detecting an object in the right-of-way and sending a signal to Loewen's onboard computer, which in turn triggers the image-capturing devices, or configured to capture still images at set intervals rather than continuous, memory-intensive video recordings), would have reduced the memory used by the system by replacing memory-intensive video recordings with photographs, thus allowing the system to take higher-resolution downward facing photos (which require less memory than constant video), thus increasing the useability of the downward-facing imagery captured by the resulting system by increasing the detail in such imagery. Moreover, Mostafa expressly discloses that the use of a nadir digital still camera "allows for covering the same ground scene with a nadir and an oblique image that, when simultaneously processed, provides a wider intersection angle

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Claim 20	Prior Art
	and thus better height accuracy." EX1007, 4. Using a still camera rather than a video camera would have also reduced hardware costs and complexity, thus fulfilling Loewen's express goal of capturing aerial images "in a cost effective manner." *E.g.*, EX1004, 2:19-21. This would have advantageously enabled the combined system to provide higher accuracy, more detailed images of captured structures (including as to the height of any transmission towers to ascertain whether such towers are leaning or their foundations have settled), the right-of-way, or other capture objectives at lower cost, increasing the usefulness of such imagery by allowing a user to discern more information from such images. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[32]

Claim 21	Prior Art
[21]: The system for capturing images and geo-	**Loewen in view of Fujimoto renders obvious claim 21.** **Additionally, Loewen in view of Fujimoto and Mostafa renders obvious claim 21.[34]**

[32] *See* n.11.

[34] Claim 1 requires that the computer system requires transmitting image-capture signals to the first and second image-capturing devices, which is disclosed by Loewen. *See* cl.1.a-cl.1.b. Further, the mapping provided above for claim 1 confirms that Loewen discloses a third image-capturing device (although that is not required by claim 1, itself). Claim 20 depends from claim 1 and 14, and requires a third image-capturing device capturing orthogonal images. As shown above, claim 20 is rendered obvious over Loewen in View of Fujimoto, or alternatively, Loewen in View of Fujimoto and Mostafa. With respect to the added requirement in claim 21, which depends from claim 20, and requires that the computer system send an image-capturing signal to the third image-capturing device, as discussed below (and in cl.1), Loewen expressly discloses or renders obvious transmitting image-capturing signals to each of its image-capturing devices (*i.e.*, all three devices

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Claim 21	Prior Art
location data corresponding thereto of claim 20, wherein the computer system transmits image-capture signals to the first image-capturing device and the second image-capturing device and the third image-capturing device to cause the first, second, and third image-capturing devices to capture images.[33]	**Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa render obvious the system for capturing images and geo-location data corresponding thereto of claim 20** (*see* cl.20)**, wherein the computer system** (*see* cl.1.d-cl.1.f (rendered obvious by Loewen in view of Fujimoto)) **transmits image-capture signals to the first image capturing device and the second image-capturing device** (*see* cl.1.a-cl.1.b (disclosed by Loewen)) **and the third image-capturing device** (*see* cl.20 (rendered obvious by Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa)) **to cause the first, second, and third image capturing devices to capture images** (*see* cl.1.f, cl.20)**.** POSITA would have understood that Loewen expressly discloses transmitting image-capture signals to each of its image-capturing devices to cause each image-capturing device to capture images. Indeed, Loewen expressly discloses "triggering the still cameras" and "tripping the shutters," and that "the computer is then able to perform real time coordination of camera tripping." EX1004, 6:51-54, 7:13-17, 7:49-53. POSITA would have understood this to be an express disclosure of triggering all of Loewen's still cameras to capture images—which, as discussed (*see* cl.20) would have included a first, second, and third image-capturing device—by transmitting image-capturing signals to each camera, thus satisfying this limitation.

addressed in claim 20 and claim 1). Additionally, Loewen in view of Mostafa also renders obvious transmitting image-capturing signals to each of its image-capturing devices. *See* cl.5, cl.20.

[33] To the extent this claim requires independent camera control, Fujimoto discloses independent camera control for at least four cameras and would render this limitation obvious for the same reasons detailed above. *See* cl.1.f; EX1005, ¶0008, Fig.2.

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Claim 21	Prior Art
	To the extent it is argued that further disclosure of transmitting image-capture signals to the third image-capturing device to cause the third image-capturing device to capture images is required, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed transmission of image-capture signals to its first and second-image capture devices to further transmit an image-capture signal to Loewen's third image-capture device, thus causing the third-image capture device to capture images. This would have advantageously provided imagery from a different viewpoint (orthogonal), which, as discussed, would have increased the usefulness of the system by providing still imagery from an additional viewpoint, thus providing the user of the system with additional views of and information about the structures or areas of interest being captured by the system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[35] As discussed (*see* cl.20), Loewen in view of Mostafa renders obvious a third image-capturing device. To the extent it is argued that further disclosure of transmitting image-capture signals to the third image-capturing device to cause the third image-capturing device to capture images is required, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed transmission of image-capture signals to its first and second-image capture devices to further include transmitting a third image-capture signal to the combined Loewen-Fujimoto-Mostafa system's third (orthogonal) image-capture device, thus causing the third-image capture device to capture images. This would have advantageously provided imagery from a different viewpoint (orthogonal), which, as discussed, would have increased the usefulness of the system by providing still imagery from an additional viewpoint, thus providing the user

[35] *See* n.11.

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Claim 21	Prior Art
	of the system with additional views of and information about the structures or areas of interest being captured by the system. For POSITA, this would have been an obvious, routine implementation choice and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[36]

Claim 26	Prior Art
[26]: The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the first and second image-capturing devices capture community	**Loewen in view of Fujimoto and Kain 1997 renders obvious claim 26.** **Additionally, Loewen in view of Fujimoto, Mostafa, and Kain 1997 renders obvious claim 26.[37]** **Loewen in view of Fujimoto and Kain 1997, or Loewen in view of Fujimoto, Mostafa, and Kain 1997 render obvious the system for capturing images and geo-location data corresponding thereto of claim 20** (*see* cl.20)**, wherein the first and second image-capturing devices** (*see* cl.1a-1.b (citing Loewen)) **capture community level oblique aerial**

[36] *See* n.11.

[37] To clarify, claim 20, on which claim 26 depends, is rendered obvious based on Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa. Claim 26 additionally requires that the first and second image-capturing devices (disclosed by Loewen, *see* cl.1.a-1.b) capture community level oblique aerial images. Claim 4, above, explains how Loewen in view of Fujimoto and Kain 1997 renders obvious a first *or* second image capturing device capturing community level oblique ariel images. Claim 20, above, explains how Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa renders obvious the first and second image-capturing devices capturing oblique aerial images. The additional limitations of claim 21 require that the *both* the first and second image-capturing devices that capture oblique aerial images (as mapped in claim 20) do so at a community level (as mapped in claim 4 in connection with at least one of the cameras). This combination, resulting in first and second image-capturing devices that capture community level oblique aerial images, is discussed below.

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Claim 26	Prior Art
level oblique aerial images.	**images** (*see* cl.4 (discussing "first or second image-capturing device captures community level oblique aerial images"), cl.20 (discussing "first and second image-capturing devices are capturing oblique aerial images")).[38] As discussed (*see* cl.4) POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement the disclosed first and second image-capturing devices of the Loewen-Fujimoto system or the Loewen-Fujimoto-Mostafa system of claim 20 that capture oblique aerial images (*see* cl.20) using Kain's advantageous disclosure of capturing images including one foot per pixel image resolution (which POSITA would have understood is a community-level aerial image consistent with the '657 patent's explanation of that term) such that the first and second image-capturing devices in the resulting system captured community-level oblique aerial images (triggered by, *e.g.*, Loewen's laser altimeter detecting an object in the right-of-way and sending a signal to Loewen's onboard computer, which in turn triggers the image-capturing devices, or configured to capture still images at set intervals rather than continuous, memory-intensive video recordings) in appropriate contexts, including for larger structures where small detail is of less concern, such as photographing the right-of-way (*i.e.*, the path defined by the tower structures and the transmission cables between towers) "to inspect the integrity of the right-of-way periodically to determine, for example, if things such as trees and other plant growth or the like have encroached into the right-of-way and is presenting a potential interference with the transmission line," and to "provide aerial images of ground structures… roadways and the like" (EX1004, 2:23-26, 5:37-41; *see also*

[38] Claim 4 requires the "first ***or*** second image-capturing devices" capture "community level oblique aerial images" whereas claim 20 requires both the first ***and*** second image-capturing devices to do so. As discussed herein, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed first and second image-capturing devices that capture oblique aerial images such that both image-capturing devices capture community level oblique aerial images.

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Claim 26	Prior Art
	id. at 2:19-21 ("Another objective of this invention is to provide a reliable and accurate record of the right-of-way of an electric transmission line, and to do so in **a cost-effective manner**.")). Capturing community-level oblique aerial images of one-foot per pixel in the foreground of the image (in contexts, as noted above, where higher-resolution images are not required, such as capturing the right-of-way or roadways or identifying downed transmission towers following a severe storm), two-feet per pixel in the mid-ground, and four-feet per pixel in the background[39] using both the first and second image-capturing devices (which Loewen expressly discloses would have advantageously allowed one camera to be oriented to capture landscape-type images and the other camera to capture portrait photographs (EX1004, 11:36-40)) would have advantageously reduced storage requirements as compared to images captured at a higher-resolution, thereby allowing for a greater number of images to be captured and stored while still providing sufficient detail for various uses of such imagery including, *e.g.*, to identify downed transmission towers following a severe storm (which would require less detailed imagery). Allowing for a greater number of images to be captured would have, *e.g.*, advantageously allowed for more views of the structures or areas of interest and/or more structures or areas of interest to be captured by the combined system in a single flight, thus increasing the coverage of the capture system. For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images of different resolution was well-known and conventional by varying well-known camera parameters (*e.g.*, field of view, sensor size) and distance from which an image is taken, and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[40]

[39] *See* n.20.

[40] *See* n.11.

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Claim 27	Prior Art
[27]: The system for capturing images and geo-location data corresponding thereto of claim 20, wherein the first and second image-capturing devices capture neighborhood level oblique aerial images.[41]	**Loewen in view of Fujimoto and Kain 2003 renders obvious claim 27.** **Additionally, Loewen in view of Fujimoto, Mostafa, and Kain 2003 renders obvious claim 27.** **Loewen in view of Fujimoto or Loewen in view of Fujimoto and Mostafa renders obvious the system for capturing images and geo-location data corresponding thereto of claim 20** (*see* cl.20)**, and Loewen discloses wherein the first and second image-capturing devices captures oblique aerial images** (*see* cl.1.a, cl.20 (citing Loewen))**.** **Kain 2003 discloses capturing neighborhood-level aerial images** (*e.g.*, "image" with "ground-sample-distance" of "0.196 ft" (approximately 2.3 inches)[42] or "0.391 ft" (approximately 4.69 inches))**.**

[41] The '657 patent states "neighborhood level[] is significantly more detailed than the community-level images" and "[o]blique neighborhood-level images have a ground sample distance of, for example, from approximately four-inches per pixel in the foreground of the image to approximately six-inches per pixel in the midground of the image, and to approximately 10 inches per pixel in the background of the image." EX1001, 13:65-9. POSITA would have understood from this exemplary, non-limiting description of certain oblique neighborhood level-images—and particularly the '657 patent's statement that neighborhood-level images are "significantly more detailed than… community-level images" and the fact that the '657 patent does not describe a category with an even more detailed level of imagery—that oblique aerial images including other lower ground sample distances (which denote a higher resolution) also qualify as "neighborhood level oblique aerial images" as that term is used in the'657 patent. As discussed (*see* n.42, *infra*) POSITA would have thus understood that Kain 2003 expressly disclosed neighborhood-level aerial images.

[42] POSITA would have understood that Kain 2003 expressly discloses an image including a ground sample distance of approximately 1.03 inches per pixel at 220 feet (an altitude expressly disclosed by Loewen (aircraft that flies approximately 100 feet above 120-foot-tall transmission towers (EX1004, 5:14-15, 5:57-61))) and

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Claim 27	Prior Art
	E.g., EX1009, Table 3:

TABLE 3

Altitude (AGL ft)	GSD (m/ft)	Image Width (m/ft)	Image height (m/ft)	Area (acre/mi^2)
500	0.060/0.196	76.3/250.3	56.7/186.0	1.1/0.0017
1000	0.119/0.391	152.6/500.5	113.4/372.0	4.3/0.0067

an image including a ground sample distance including 4 inches per pixel at approximately 841 feet, which POSITA would have been able to readily ascertain using simple ratios (*i.e.*, multiplication and division) based on Kain 2003's other expressly-disclosed ground-sample distance values at other altitudes such as 500 feet and 1000 feet. EX1009, Table 3. Additionally, to the extent it is argued further disclosure of ground sample distances including 4 inches per pixel at lower altitudes, such as 220 feet, is required, POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Kain 2003's expressly-disclosed 4 inches per pixel ground sample distance at approximately 841 feet at, instead, lower altitudes such as 220 feet for appropriate applications, as doing so would have allowed for the capture of higher resolution images at lower altitudes that would be more likely to be below cloud cover, thereby increasing visibility and allowing the capture of images on many more days per year (as opposed to only on days without significant cloud cover for systems that capture at higher altitudes). Moreover, Loewen expressly discloses that the user of lower altitudes allows "the use of advantageous exposure parameters (shutter speed, lens opening and resulting depth of field) for the cameras." EX1004, 2:53-56. For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images at different resolutions was well-known and conventional and could be easily done by varying well-known camera parameters (*e.g.*, field of view, sensor size) and clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.

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Claim 27	Prior Art

TABLE 3-continued

Altitude (AGL ft)	GSD (m/ft)	Image Width (m/ft)	Image height (m/ft)	Area (acre/mi^2)
2000	0.238/0.782	305.1/1001.0	226.8/744.1	17.1/0.0267
3000	0.357/1.173	457.7/1501.5	340.2/1116.1	38.5/0.060
4000	0.477/1.564	610.2/2002.0	453.6/1488.1	68.4/0.107
6000	0.715/2.346	915.3/3003.1	680.4/2232.2	153.9/0.240
8000	0.953/3.128	1220.4/4004.1	907.2/2976.3	273.6/0.427
10000	1.192/3.910	1525.6/5005.1	1134.0/3720.3	427.5/0.668

POSITA would have been motivated and found it obvious, straightforward, and advantageous to implement Loewen's disclosed first and second image-capturing devices that capture oblique aerial images (in the combined Loewen-Fujimoto or Loewen-Fujimoto-Mostafa systems (*see* cl.20)) using Kain 2003's advantageous disclosures of neighborhood-level aerial images including ground sample distances of, *e.g.*, 1.03 inches per pixel, 2.3 inches per pixel, 4 inches per pixel, and 4.69 inches per pixel in, for example, the foreground, with increasing values (*i.e.*, lower resolutions) in the mid-ground and background due to Loewen's expressly disclosed camera angles ranging from 30-60 degrees including, preferably, 45 degrees (*see* n.1; *see also* EX1009, ¶39 ("actual achieved ground-sample distance is slightly higher than the ground-sample distance at the center pixel of the camera due to the geometry") and what POSITA would have understood were fields of view at the upper end of the range of conventional and well-known fields of view, which POSITA would have understood are oblique neighborhood-level images. *See* n.1. POSITA would have understood that capturing more detailed neighborhood-level oblique aerial images including ground sample distances of, *e.g.*, four inches per pixel in the foreground of the image would have produced images of a higher resolution, advantageously allowing for more highly detailed views of structures or areas of interest, such as detailed views of transmission towers, wire attachment points to those towers, and of wires themselves, thus increasing the usability of images captured with the combined system. *E.g.*,

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Claim 27	Prior Art
	EX1004, 2:34-36 ("capture high resolution images of the electric transmission line tower structures and equipment attached to those towers"). For POSITA, this would have been an obvious, routine implementation choice, particularly given that obtaining images of higher resolution was well-known and conventional and could be easily done by varying well-known camera parameters (*e.g.*, field of view, sensor size) and distance from which an image is taken—*e.g.*, it would have been beneficial to operate the combined system at higher altitudes to, for example, better capture downed transmission towers or scattered wires following a severe storm that would otherwise not be fully visible from, *e.g.*, 80-100 feet above intact transmission towers (which Loewen discloses are from 80-120 feet high (EX1004, 5:14-15)) or to capture images at a higher altitude where required by flight regulations that do not permit lower-altitude flights over certain areas such as powerplants, where transmission towers are likely to be located)—and it would have been clear to POSITA that it would work, predictably yielding the expected functionality with a reasonable expectation of success.[43]

[43] *See* n.11.

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