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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte CASSIO WALLNER, PAULO ANCHIETA DA SILVA, RICARDO ROGULSKI, RICARDO PINHEIRO RULLI, and TOMAZ LAZANHA

Appeal 2020-001152
Application 13/335,268
Technology Center 3600

Before RICHARD M. LEBOVITZ, FRANCISCO C. PRATS, and JAMIE T. WISZ, *Administrative Patent Judges*.

LEBOVITZ, *Administrative Patent Judge*.

DECISION ON APPEAL

The Examiner rejected the claims under 35 U.S.C. § 102 as anticipated, under 35 U.S.C. § 103 as obvious, and under 35 U.S.C. § 101 as reciting patent ineligible subject matter. Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject the claims. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as Embraer S.A. Appeal Br. 1.

STATEMENT OF THE CASE

The Examiner finally rejected the claims as follows:

1. Claims 1, 10, 12, 13, 15, 22, 24, and 30 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent et al. (US 2004/0176887 A1, published Sep. 9, 2004) ("Kent"), Torng (US 2009/0240468 A1, published Sep. 24, 2009) ("Torng"), Sinex (US 6,442,459 B1, issued Aug. 27, 2002) ("Sinex"), Cerreta et al. (US 2010/0186519 A1, published Jul. 29, 2010) ("Cerreta"), Nakagawa et al. (US 6,370,839 B1, issued Apr. 16, 2002) ("Nakagawa"). Final Act. 5.

2. Claims 4 and 16 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent, Torng, Sinex, Cerreta, Nakagawa, and Sweeney et al. (US 2003/0111525 A1, published Jun. 19, 2003) ("Sweeney"). Final Act. 57.

3. Claims 8 and 20 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent, Torng, Sinex, Cerreta, Nakagawa, and Fields (US 2003/0088373 A1, published May 8, 2003) ("Fields"). Final Act. 63–64.

4. Claims 11 and 23 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent, Torng, Sinex, Cerreta, Nakagawa, and Isobe et al. (US 6,636,813 B1, issued Oct. 21, 2003) ("Isobe"). Final Act. 71–72.

5. Claims 31 and 33 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent, Torng, Sinex, Cerreta, Nakagawa, and Stothers et al. (US 2009/0070048 A1, published Mar. 12, 2009) ("Stothers"). Final Act. 76.

6. Claims 32, 35 and 36 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent, Torng, Sinex, Cerreta, Nakagawa, and Giurgiutiu et al. (US 2010/0042338 A1, published Feb. 18, 2010) ("Giurgiutiu"). Final Act. 78–79.

7. Claim 34 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent, Torng, Sinex, Cerreta, Nakagawa, and Akdeniz et al. (US 2007/0056375 A1, published Mar. 15, 2007) ("Akdeniz"). Final Act. 81.

8. Claim 37 under pre-AIA 35 U.S.C. § 103(a) as obvious in view of Kent, Torng, Sinex, Cerreta, Nakagawa, and Martin (US 4,888,076, issued Dec. 19, 1989) ("Martin"). Final Act. 83.

9. Claims 1, 4, 8, 10-13, 15, 16, 20, 22, 23, 24, and 30–37 under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter. Final Act. 2.

Independent claim 1 is representative and is reproduced below. The claim is annotated with bracketed numbers for reference to the claim limitations.

> 1. A method, implemented at least in part by at least one computer including a processor, and a storage device coupled to the processor, of analyzing and assessing structural damage to an aircraft during operation of the aircraft, the method comprising:
>
> [1] sensing, with at least one sensor during operation of the aircraft, aircraft structural damage data related to aircraft structural damage sustained by the aircraft; and
>
> [2] automatically, with at least one processor, analyzing the sensed aircraft structural damage data and determining a damage disposition based on results of the analyzing, including automatically with the at least one processor:
>
> [3] during operation of the aircraft, comparing the sensed aircraft structural damage data with at least one predetermined limit specified in structural repair manual associated with the aircraft;
>
> [4] based on the comparing, selectively performing a specific structural analysis for detected damage considering plural parameters including damage type, geometry and dimensions of damaged areas, material parameters, and

structure loads, wherein said specific structural analysis includes static, fatigue and damage tolerance structural analysis;

[5] automatically determining, in response to the comparing and results of the specific structural analysis, a damage disposition including specifying categories as allowable damage, fly-by, temporary repair, permanent repair, and contacting the aircraft manufacturer for specific disposition, said damage disposition determining including automatically determining damage severity indicative of whether the aircraft is in a condition for safe flight or alternatively whether the aircraft needs to be removed from operation for repair, and using results of the additional specific structural analysis to automatically determine the number of flight cycles allowed before repair when the at least one processor determines a repair is needed; and

[6] generating an analysis results report based on the determined damage disposition and results of the specific structural analysis.

1. REJECTION BASED ON KENT, TORNG, SINEX, CERRATA, AND NAKAGAWA

The Examiner found that Kent describes a method for "assessing structural damage to an aircraft during operation of the aircraft" using a computer as recited in claim 1. Final Act. 5–8. The Examiner found that Kent's method comprises the same steps as claim 1. *Id.* The Examiner found that Kent does not explicitly teach "comparing the sensed aircraft structural damage data with at least one predetermined limit" as recited in step [3] of claim 1. *Id.* at 8–9. To meet this deficiency, the Examiner further relied upon Torng for its teaching that "traditional aircraft structural integrity programs (ASIP) damage tolerance requirements use a set of design standards to determine the inspection and repair schedule." Torng ¶ 44 (referenced at Final Act. 9). The Examiner concluded that it would have been obvious to one of ordinary skill in the art to apply Torng's teachings to Kent to determine an inspection and repair schedule. Final Act. 9, 11.

The Examiner further found that neither Kent nor Torng describes making the comparisons to a "structural repair manual" as recited in step [3] of claim 1, but found that Sinex "teaches it is known to compare the assessed data and damage to a Structural Repair Manual and to use this comparison to suggest or select actions to be taken." Final Act. 12. The Examiner determined it would have obvious to apply Sinex to the teachings in Kent and Torng to "ensure that the maintenance personnel in Kent comply with the requirements set forth by the manufacturer of the aircraft and outlined in the Structural Repair Manual." *Id.*

The Examiner further relied on Cerreta for its disclosure of different tests for damage, including static analysis (Final Act. 14–15) (step [4] of claim 1) and Nakagawa for teaching contacting the aircraft manufacturer for specific damage disposition (step [5] of claim 1) (Final Act. 16–18).

Discussion

Appellant traverses the rejection. We address the arguments below.

Appellant argues that Kent never uses the term "damage" as recited in claim 1 nor discloses "any attempt to analyze or quantify structural damage." Appeal Br. 7. Rather, Appellant contends that Kent "is directed to a different kind of analysis altogether: fault detection and fault prediction." *Id.* Appellant also argues that Kent does not have the ability to determine and quantify the severity of structural damage. *Id*. Instead, Appellant asserts "Kent merely discloses determining whether there is a fault or predicting when a fault may occur in the future." *Id.*

Appellant's argument is not supported by the evidence in this record. The health management system described in Kent "relates to the structure of the aircraft which monitors various system parameters, for example, but not limited to, vibration, pressure, temperature, strain and moisture content of the vehicle structure." Kent ¶ 40. Kent further explains:

> As shown in FIG. 2, the on-board ACAMS system 100 [Aircraft Condition Analysis and Management System] accepts data from a[n] on-board data bus 500, such as, but not limited to, an MIL STD 1553 data bus, for real-time analysis. The data bus 500 *receives signals from*, for example, but not limited to, an engine 501, *structure 502 of the aircraft*, flight controls 503 of the aircraft, avionics controls 504, and Global Positioning System (GPS) 505. The ACAMS system 100 then uses information fusion and onboard reasoning processes for diagnosis, prognosis, fault isolation, and identification of component or components responsible for faulty conditions to cue operators and/or maintenance personnel to ensure that parts are available for repair or replacement, appropriate maintenance is performed, and assets are deployed in time for the next mission.

Kent ¶ 45 (emphasis added).

Paragraph 40 therefore provides evidence that the "structure" of the aircraft is monitored.

The use of sensors and the type of faults that are identified using the sensors is also described by Kent:

> The information sources that are used for formulating the models include, for example, but not limited to, . . . emerging sensors 128 to include new physical sensors including, but not limited to, micro-electromechanical systems, fiber optics, ultrasonic sensors, and acoustic emission sensors, for characterization of component and *system-level degradation, especially in structural materials*.

Kent ¶ 55 (emphasis added).

Degradation in structural materials is therefore expressly described by Kent. As explained below, the evidence supports the Examiner's finding that the "degradation" in structural material disclosed by Kent meets the claim limitation of "structural damage."

The Specification does not provide a definition of "structural damage," the limitation that Appellant asserts is not disclosed by Kent, but it does provide guidance. Specifically, the Specification discloses:

> *Aircraft in service are susceptible to corrosion*, fatigue and accidental damages, which can be induced by service loads, environmental conditions or accidental impacts. These structural damages can be detected during a scheduled maintenance or during the aircraft operation (walk[-]around inspections).

Spec. ¶ 4 (emphasis added).

Corrosion, which is "to eat or wear away gradually" or "to impair; deteriorate"[2] is reasonably interpreted to include "degradation" of structural materials as described in Kent ¶ 55 (reproduced above). Consequently, while Kent may teach various types of fault detection as asserted by Appellant (Appeal Br. 7–9), Kent explicitly describes detecting degradation in structural materials which is the same type of structural damage disclosed in the Specification (¶ 4 reproduced above; ¶ 13 ("Measurement of structural integrity degradation can be a complex task.).

Appellant also argues that Kent does not described what is disclosed in "non-limiting embodiments" of the Specification:

> In applicant's non-limiting embodiments, in-service monitoring determines when structural damage has occurred, automatically assesses the extent of the damage, and then refers the situation to the aircraft manufacturer when detected damage is out of limits that can be handled by normal maintenance operations. See e.g.,

[2] https://www.dictionary.com/browse/corrode

> para. 33. Kent discloses nothing like this. Furthermore, Kent fails to suggest automatic deployment of specific structural analysis in order to improve damage disposition as applicant provides at e.g. para. 34.

Appeal Br. 9.

Appellant does not identify what limitations in the claim correspond to these so-called "non-limiting embodiments." However, it appears that Appellant is arguing that Kent does not disclose step [2] of claim 1 of "automatically, with at least one processor, analyzing the sensed aircraft structural damage data and determining a damage disposition based on results of the analyzing, including automatically with the at least one processor" and limitation [5] of "contacting the aircraft manufacturer for specific disposition." We do not agree with Appellant that these limitations are not described in the prior art cited by the Examiner.

The Examiner cited specific paragraphs in Kent where step [2] of the claim is described. Final Act. 6–7 (citing Kent ¶¶ 49, 52, 55–57, 61). Appellant did not sufficiently address these specific disclosures in asserting that step [2] is not described by Kent. For example, paragraph 61 of Kent describes the ACAS system as accepting data from multiple sources and as containing "internal algorithms that relate tests derived from sensor responses and other information sources to fault conditions within the system of interest," which indicates that the analysis is performed automatically with a processor as required by the claim. Because Kent describes collection of data about degradation in structural materials (Kent ¶ 55), one of ordinary skill in the art would reasonably understand that the "physical sensor data" used by the ACAMS system in paragraph 61 would include the data involving the degradation of structural materials.[3] Appellant has given no adequate reason why such a finding is not correct.

Kent also determines "damage disposition" as required by step [2] of the claim. Kent describes determining which "components must be repaired immediately . . . in accordance with in accordance with FAA guidelines of the minimum equipment list necessary to operate and dispatch aircraft." Kent ¶ 61. Thus, Kent determines what to do about the damage once it is detected.

Appellant contends that Kent does not describe assessing the severity of damage. Appeal Br. 8 (see step [5] of claim 1 reciting "determining damage severity indicative of whether the aircraft is in a condition for safe flight"). However, the Examiner identified paragraphs 46, 49, and 61 of Kent as teaching determining damage severity. Final Act. 25, 46–47. In paragraph 61, Kent discloses determining equipment necessary to operate and dispatch aircraft and complete mission and "[w]hen a fault condition requiring immediate action (as defined by such user or regulatory authority guidelines) is indicated, the health management system sends message to the on-board datalink and a message that identifies the suspect component(s) is sent to a maintenance or dispatch terminal, or decision-making authority." Thus, the skilled worker would reasonably understand that determining whether a fault requires immediate attention or not is determining its severity.

[3] "As shown in FIG. 7, the ACAMS system accepts data from multiple information sources, including, but not limited to, physical sensor data (e.g., strain, moisture, acceleration, vibration, pressure, temperature, wheel speed and chemical by-products)."

Kent does not just predict faults as asserted by Appellant (Final Act. 8); Kent also identifies them (¶ 41: "The ACAMS system 100 monitors the various subsystems, identifies or predicts faults in the subsystem, and sends data to an on-board datalink. The ACAMS system 100 then sends a message, that identifies the suspect component(s), to a maintenance, dispatch terminal or decision-making authority.") As discussed above. Appellant is reading "fault" too narrowly; Kent has specific disclosure in detecting degradation in structural materials, and provides examples of sensors that do so. Kent ¶ 55.

Appellant states that "Torng does not disclose any sensors or any automatic means by which structural damage could be assessed during operation." Appeal Br. 10. However, the Examiner cited Kent for this disclosure as discussed above. This argument thus has no merit.

Appellant also argues:

> The Office Action does not adequately explain why one skilled in the art would combine Torng's risk assessment prediction system with Kent's in-operation fault isolation and detection system. The Examiner for example has not demonstrated that the exceedingly complex analysis that Torng performs on a web server based on multiple periodic inspections at deterministic inspection intervals could be used by Kent's fault detection system.

Appeal Br. 10.

Appellant further contends with respect to Torng that the Examiner "has not demonstrated a prima facie case of how Kent could be modified with Torng to meet applicant's structural damage claim limitations." Appeal Br. 11. Appellant asks that, if Kent is able to detect structural damage, "why would one skilled in the art combine Kent with Torng's probabilistic prediction system? He would not. Furthermore, Torng also does not detect structural damage but instead predicts when it may occur in the future and thus schedules inspection before that occurs." *Id.*

Appellant's arguments with respect to Torng are not persuasive. The Examiner cited Torng for teaching step [4] of "selectively performing a specific structural analysis for detected damage considering plural parameters including damage type, geometry and dimensions of damaged areas, material parameters, and structure loads, wherein said specific structural analysis includes static, fatigue and damage tolerance structural analysis." Final Act. 10. For this limitation, the Examiner cited paragraphs 32, 36–39, and 40–45 of Torng. Final Act. 10. While Torng does not disclose specific sensors, Torng identifies several parameters of the aircraft's structure that are measured, including "material parameters, and stress intensity solution (α=K/cσ)." Torng ¶ 32. *See also* Torng ¶ 41 ("Such input data includes K/sigma versus a file (geometry), a fracture toughness distribution, an initial crack size distribution, an a versus T file (a crack growth curve), a maximum stress Gumbel distribution"). Thus, Torng expressly teaches performing a structural analysis as required by the claim. The reason that Torng does not describe the actual sensors that collect this data is that Torng's invention is not directed to how these measurements are made. Appellant has not established that Torng combined with the sensors described by Kent, and the knowledge of one of ordinary skill in that art, was not enabled at the time of the invention to make the measurements described in Torng.

Appellant's argument that there was no reason to combine Torng with Kent because Kent already detects structural damage is not persuasive. The Examiner cited Torng, as explained above, for performing a type of structural analysis. That is, the Examiner cited Torng for its more detailed structural analysis as described in paragraphs 32, 36–39, and 40–45 of Torng. Final Act. 10. Appellant did not identify a deficiency in these paragraphs as they relate to limitation [4] of claim 1. Appellant also did not explain why Torng's analysis, including the equations disclosed in it (Torng ¶¶ 41, 45) are not applicable to Kent when Kent also describes algorithms in its structural analysis (Kent ¶¶ 52, 51).

The Examiner also provided a reason to apply Torng to Kent: "for the purposes of establishing the expected strength of the component or part and to determine the schedule for inspection and maintenance as taught in Torng." Final Act. 11. Appellant's contention that Examiner's reason was inadequate is not persuasive because Appellant did not address the full statement made by the Examiner, but rather quoted only a part of it. Appeal Br. 11.

The Examiner cited Sinex to meet step [3] of claim 1 of "during operation of the aircraft, comparing the sensed aircraft structural damage data with at least one predetermined limit specified in structural repair manual associated with the aircraft." Final Act. 12. The Examiner reasoned that it would have been obvious to compare the damage assessed in Kent to the Structural Repair Manual described in Sinex because "Sinex is a required document that is used to determine what tasks need to be performed" and this "would ensure that the maintenance personnel in Kent comply with the requirements set forth by the manufacturer of the aircraft and outlined in the Structural Repair Manual." *Id.*

Appellant argues that Sinex's teachings "about managing and scheduling maintenance tasks across an entire fleet of aircraft" and "a system that provides a structural repair manual online for reference by maintenance personnel" "says nothing" about the disputed limitation. Appeal Br. 12.

We do not agree. Sinex discloses that a tracking manager compares data to the online manual ("MLB"; col. 1, ll. 35–56) to determine what tasks to perform. Sinex, col. 4, ll. 28–34. Sinex teaches maintaining online documents, including structural repair manuals (*id.* at col. 4, ll. 45–48; col. 15, ll. 15–43) to facilitate aircraft maintenance:

> The present invention is a system for enabling an operator to dynamically manage maintenance of an aircraft. The system includes a program manager system, a tracking manager system and a production manager system. The program manager system is for extracting maintenance tasks from aircraft maintenance publications, and for guiding the formation of maintenance tasks groups.

Sinex, col. 3, ll. 29–35.

While Sinex does not expressly state using the tracking manager to compare damage data to an online repair manual, Sinex compares data to a manual to determine when maintenance tasks should be performed. Sinex, col. 4, ll. 28–34. Thus, Sinex teaches using the manual as a reference to maintain an aircraft in "airworthy condition" (Sinex, col. 1, ll. 29–33). Kent and Torng teach a part of maintaining an aircraft in airworthy condition is determining damage and the risk of failure. Thus, as found by the Examiner, it would be obvious to use the repair manual to not only to determine when to perform maintenance tasks, but also to assess and repair structural damage, which is part of maintaining the condition of a plane. Consequently, we find Appellant's argument regarding Sinex to be unpersuasive.

The Examiner cited Cerreta for describing various types of tests to be performed on an aircraft, including teaching that the "specific structural analysis includes static, fatigue and damage tolerance structural analysis" as recited in step [4] of claim 1. Appellant argues that there is no proper basis for combining the "huge test fixture for testing fuselage parts" of Cerreta. Appeal Br. 12–13.

We are not persuaded by this argument that the Examiner erred. The Specification does not provide any guidance on how the static and fatigue analysis of step [4] is performed. Spec. ¶¶ 10, 35, 36. Appellant has not adequately explained why the device in Ceretta which measures strain, load, etc., has transducers, and has "electric cables for transferring data" (Ceretta ¶ 22) could not serve as the sensors to perform the required structural analysis recited in the claim.

Appellant states the analysis must be performed when the aircraft is "operating in flight." Appeal Br. 13. We do not agree. The claim only specifies that the damage is assessed "during operation of the aircraft," not that it must be in flight. Step [5] of the claim states the method determines whether the "aircraft is in a condition for safe flight," indicating that the method covers instances where a determination is made as to whether the aircraft will be dispatched for flight; therefore the aircraft cannot already be in-flight. *See also* Spec ¶ 4 ("These structural damages can be detected during a scheduled maintenance or during the aircraft operation (walk[-]around inspections"; "when the damage is detected during the aircraft operation, the damage severity will determine whether the aircraft is in a condition for safe flight or whether it needs to be promptly removed from operation for repair.").[4] Based on the claim language and this disclosure in the Specification, we interpret "during operation of the aircraft" to mean that that the engine, for example, of the aircraft is operating.

Step [5] of claim 1 recites "damage disposition including specifying categories as allowable damage, fly-by, temporary repair, permanent repair, and contacting the aircraft manufacturer for specific disposition." To meet this limitation, the Examiner cited Nakagawa. Final Act. 16.

Appellant states the disclosure in Nakagawa has nothing to with assessing structural damage in an aircraft. Appeal Br. 13.

This argument is not persuasive. The Examiner cited Nakagawa for its teaching of contacting the manufacturer to determine damage disposition. The Examiner found that "Nakagawa, like Kent talks about servicing equipment, teaches it is known when servicing a piece of equipment to either look into manuals for the proper disposition or to contact the manufacturer for the specific instructions for the disposition." Appeal Br. 16. The Examiner cited column 2, lines 35–42 of Nakagawa which teaches, in part: "Upon noticing the failure, the operator performs a recovery procedure either by looking into the manuals, etc. for a proper operation corresponding to the lamp indication or by contacting a manufacturer for instructions." Thus, the Examiner's reason for citing Nakagawa is supported by the evidence. "Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a

[4] It is commonsense that a walk-around inspection performed during "aircraft operation" cannot be performed while the aircraft is in–flight and in the air.

combination of references." *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986).

For the foregoing reasons, the obviousness rejection of claim 1 is affirmed. Claims 10, 12, 13, 15, 22, 24, and 30 were not argued separately and fall with claim 1. 37 C.F.R. § 41.37(c)(1)(iv).

2. REJECTION FURTHER BASED ON SWEENEY

Appellant argues that Sweeney does not cure the deficiencies of Kent, Torng, Sinex, Cerreta, and Nakagawa. Appeal Br. 14. We thus affirm the rejection of claims 4 and 16 for the same reasons as described for claim 1.

3. REJECTION FURTHER BASED ON FIELDS

The Examiner further cited Fields to meet the limitation recited in dependent claims 8 and 20 reciting "further including the at least one processor selectively performing a static and fatigue analysis based on tensile, compression, buckling, post-buckling, crippling and/or durability failure criteria, and using the results of said static and fatigue analysis to determine damage disposition." The Examiner found that Fields describes static and field analysis comprising measuring "buckling" as required by the claims. Final Act. 65. The Examiner determined it would have been obvious to one of ordinary skill in the art to perform Fields's analysis in Kent "to determine the acceptable margin of safety and determine if the component in question can handle the forces being applied to it." Final Act. 67. The Examiner found that this analysis "would assist in ensuring that the components in their current state can continue to handle the stress applied to them or they need to be replaced." *Id.*

Appellant argues that the Examiner did not explain how Fields's "design system could be used in conjunction with damage detection on an operating aircraft." Appeal Br. 14. Appellant states that Fields "seems to not use any actual input from operating aircraft but rather attempts to simulate stresses on theoretical structures." *Id.* Appellant also argues that there "is no indication that either Kent or Torng would be interested in buckling for example." *Id.*

As explained above, the Examiner found that the skilled worker had reason to apply Fields's analysis to Kent to ensure the safety of the parts used in the aircraft. Final Act. 65, 67. Appellant did not identify a defect in this reasoning. Contrary to Appellant's argument that Fields does not use actual input, Fields teaches performing "actual stress" measurements using a commercially available system. Fields ¶ 46. Fields also teaches the importance of fatigue analysis "to determine if the elements can withstand the extreme forces to which the aircraft is subjected over its lifetime" and identifies buckling as part of the analysis (Fields ¶ 37), providing a reason to apply to Kent to ensure aircraft safety as found by the Examiner.

The obviousness rejection of claims 8 and 20 is affirmed.

4. REJECTION FURTHER BASED ON ISOBE

The Examiner cited Isobe to meet the limitations in claims 11 and 23 of crack propagation and analysis. Final Act. 72. Appellant argues that Isobe's "use of manual inspection data on gas turbine crack location and size does not inform one skilled in the art how to modify Kent and the other references along the line of the claimed invention." Appeal Br. 15. This argument is not persuasive. The Examiner explained why it would have been obvious to apply Isobe to Kent. Final Act. 72–73. Appellant did not identify a defect in this fact-based reasoning. The rejection is therefore affirmed for the reasons given by the Examiner.

5. REJECTION FURTHER BASED ON STOTHERS

Appellant did not provide separate arguments for the patentability of claims 31 and 33 further based on Stothers. Appeal Br. 15–16. Thus, these claims fall with claim 1.

6. REJECTION FURTHER BASED ON GIURGIUTIU

The Examiner further rejected claims 32, 35, and 36 based on the additionally cited publication by Giurgiutiu. Final Act. 78–79. Claim 32, depends from claim 1, and further recites "wherein at least one sensor operates to perform Non-Destructive Inspection based on measuring eddy currents, xRays, die penetration or ultrasound." Claims 35 and 36 depend from claim 32. The Examiner found that "Giurgiutiu, which like Kent talks about detecting structural damage, teaches it is known to collect data using Non-Destructive Inspection comprising eddy currents, xRays, die penetration or ultrasound, the sensor comprises a Lamb waves sensor, and wherein the sensor senses electro-mechanical impedance (Abstract, page 1, paragraph [0004]." Final Act. 79. The Examiner concluded that because "Kent already detects structural damage it would have been obvious to use any one of these known techniques to do so." *Id.*

Appellant states that the rejection is improper because how is the oscilloscope of Giurgiutiu "supposed to be on board an aircraft"?" Appeal Br. 16.

Giurgiutiu explains that an oscilloscope receives signals from the sensors used to make the measurements. Giurgiutiu ¶ 28. The oscilloscope is used to display the signals. *Id.* Appellant has not established that the oscilloscope is necessary to analyze the signals received from the sensors or that the display is necessary to perform the analysis described by Giurgiutiu. Accordingly, Appellant's argument is unavailing and the rejection is affirmed.

7. REJECTION FURTHER BASED ON AKDENIZ

The Examiner further rejected claim 34 based on the additionally cited publication by Akdeniz. Final Act. 81. Claim 34, depends from claim 1, and further recites "wherein the at least one sensor performs comparative vacuum monitoring." The Examiner found that "Akdeniz, which like Kent talks about determining structural damage, teaches it is known to perform comparative vacuum monitoring to determine structural damage (Abstract, Page 1, paragraph [0008]" and that "comparative vacuum monitoring is one of several known ways of monitoring the structural health of airplanes." Final Act. 81. The Examiner concluded that because "Kent is monitoring the structure of airplanes it would have been obvious to use these known techniques to accomplish this goal." *Id.*

Appellant argues there is no suggestion to combine Akdeniz with Kent. Appeal Br. 16. Appellant also contends that, based on paragraph 4 of Akdeniz, "one skilled in the art would never select Akdeniz's vacuum sensor teaching for an automatic inflight inspection system." *Id.*

We are not persuaded that the Examiner erred. The Examiner gave a reason for combining Kent with Akdeniz. Appellant did not identify a flaw in the reasoning and we find none. Paragraph 4 of Akdeniz describes a sensor for determining the damage. Appellant did not provide a reason as to why the sensor could not be used to monitor the aircraft during operation, for example, when the engine is running. Appellant's argument that it could not be used for "inflight" operation reads a limitation that does not appear in the claim. As discussed above, the claim does not require the aircraft to be flying when the sensors perform the measurements.

8. REJECTION FURTHER BASED ON MARTIN

The Examiner further rejected claim 37 based on the additionally cited publication by Martin. Final Act. 83. Claim 37, depends from claim 1, and further recites "wherein the at least one sensor senses optical characteristics." The Examiner found that "Martin, which like Kent talks about monitoring structural damage, teaches it is known to use optical sensors . . . to determine if damage has occurred." Final Act. 83. The Examiner concluded because "Kent is monitoring the structure of airplanes it would have been obvious to use these known techniques to accomplish this goal." *Id.*

Appellant argues "Martin's method for molding an optical fiber into fiberglass is non-analogous to Kent's real time aircraft fault monitoring" and that the Examiner did not "demonstrate that Martin's technique could be used to sense structural damage on board a modern aluminum frame aircraft." Appeal Br. 17.

We do not agree. The Examiner cited Martin at column 4, line 64 to column 5, line 11, for its teaching of using optical fibers to detect structural damage. Appellant has provided no evidence that this technique could not be applied to an aircraft. Because it is a technique used to assess damage and Kent's purpose is to assess damage to an aircraft, Martin is "reasonably pertinent" to Kent and the claimed subject matter and therefore analogous art.[5] The rejection is affirmed.

REJECTION BASED ON 101

Principles of Law

Under 35 U.S.C. § 101, an invention is patent-eligible if it claims a "new and useful process, machine, manufacture, or composition of matter." However, not every discovery is eligible for patent protection. *Diamond v. Diehr*, 450 U.S. 175, 185 (1981). "Excluded from such patent protection are laws of nature, natural phenomena, and abstract ideas." *Id.* The Supreme Court articulated a two-step analysis to determine whether a claim falls within an excluded category of invention. *Alice Corp. Pty. Ltd. v. CLS Bank*

[5] It is well-established that there are two criteria to be applied when determining whether a reference is analogous prior art: (1) whether the reference is from the "same field of endeavor" as the claimed invention, and (2) if the reference is not within the same field of endeavor, "whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved." *In re Clay*, 966 F.2d 656, 658–59 (Fed. Cir. 1992). A reference is "reasonably pertinent" to the inventor's particular problem when the reference "is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem." *In re Klein*, 647 F.3d 1343, 1348 (Fed. Cir. 2011) (citation omitted).

Int'l, 134 S.Ct. 2347 (2014); *Mayo Collaborative Servs. v. Prometheus Labs, Inc.*, 566 U.S. 66, 75–77 (2012).

In the first step, it is determined whether the claims at issue recited one of those patent-ineligible concepts. *Alice*, 134 S.Ct. at 2355. If it is determined that the claims recite an ineligible concept, then the second step of the two-part analysis is applied in which it is asked "[w]hat else is there in the claims before us?" *Id.* The Court explained that this step involves

> a search for an 'inventive concept' — *i.e.,* an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself.'

Alice, 134 S.Ct. at 2355 (citing from *Mayo*, 566 U.S. at 75–77).

Alice, relying on the analysis in *Mayo* of a claim directed to a law of nature, stated that in the second part of the analysis, "the elements of each claim both individually and 'as an ordered combination'" must be considered "to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Alice*, 134 S.Ct. at 2355.

The PTO published guidance on the application of 35 U.S.C. § 101. USPTO's January 7, 2019 Memorandum, *2019 Revised Patent Subject Matter Eligibility Guidance,* 84 Fed. Reg. 50, 51–57 (2019) ("Eligibility Guidance"). This guidance provides additional direction on how to implement the two-part analysis of *Mayo* and *Alice*.

Step 2A, Prong One, of the 2019 Guidance, looks at the specific limitations in the claim to determine whether the claim recites a judicial exception to patent eligibility. In Step 2A, Prong Two, the claims are examined to identify whether there are additional elements in the claims that integrate the exception in a practical application, namely, is there a "meaningful limit on the judicial exception, such that the claim is more than a drafting effort designed to monopolize the judicial exception." 84 Fed. Reg. 54 (2. Prong Two).

If the claim recites a judicial exception that is not integrated into a practical application, then as in the *Mayo/Alice* framework, Step 2B of the Eligibility Guidance instructs us to determine whether there is a claimed "inventive concept" to ensure that the claims define an invention that is significantly more than the ineligible concept, itself. 84 Fed. Reg. 56.

With these guiding principles in mind, we proceed to determine whether the claimed subject matter in this appeal is eligible for patent protection under 35 U.S.C. § 101.

Discussion

Claim 1 is directed to a "method." Following the first step of the *Mayo/Alice* analysis, we find that the claim is directed a "process," and therefore falls into one of the broad statutory categories of patent-eligible subject matter under 35 U.S.C. § 101. We thus proceed to Step 2A, Prong One, of the Eligibility Guidance.

Step 2A, Prong One

In Step 2A, Prong One, of the Eligibility Guidance, the specific limitations in the claim are examined to determine whether the claim recites a judicial exception to patent eligibility, namely whether the claim recites an abstract idea, law of nature, or natural phenomenon.

The Final Action was mailed before the publication of the 2019 Revised Patent Subject Matter Eligibility Guidance; however, the

Examiner's Answer was mailed afterwards. Consequently, we shall refer to the Answer which was published after the Eligibility Guidance.

In the Answer, the Examiner indicated that the recited "assessing can be performed by human" and that the "computer is merely acting as a tool to compare information after it is entered." Ans. 8. Based on this discussion, we understand the Examiner to be finding that at least some of the steps of claim 1 can be performed in the human mind and therefore fall into the category of mental processes listed in the Eligibility Guidance. 84 Fed. Reg. 52 "(c) Mental processes."

We agree with the Examiner's determination. We begin with the claims.

Step [1] of the claim is sensing damage with a sensor. In step [2], the damage data from the sensor is "automatically" analyzed with a processor and a "damage disposition" is determined. Steps [3]–[5] are the steps in claim 1 in which the disposition of the damage is determined.

Specifically, step [3] of the claim compares "the sensed aircraft structural damage data with at least one predetermined limit specified in structural repair manual associated with the aircraft." This comparison could be accomplished in the human mind by referring to the manual and then determining how the damage compares to the damage limits listed in the manual. It is therefore a mental step and an abstract idea. Once the comparing is done, "a specific structural analysis for detected damage" is done in step [4] which "includes static, fatigue and damage tolerance structural analysis." This step does not fall into any of the enumerated categories of abstract ideas listed in the Eligibility Guidance.

In step [5], the results of step [3] and [4] are used to determine a "damage disposition." The disposition includes "specifying categories as allowable damage, fly-by, temporary repair, permanent repair, and contacting the aircraft manufacturer for specific disposition," a step which could be done in the human mind because a human could make such a comparison and evaluation in their mind. It is therefore a mental step and an abstract idea.

The disposition also includes "determining including automatically determining damage severity indicative of whether the aircraft is in a condition for safe flight or alternatively whether the aircraft needs to be removed from operation for repair." The claim does not specify how this result is accomplished. A human could look at the damage and then make the mental judgement of whether the aircraft is safe for flight or whether it needs repair. The Specification indicates that damage assessments were conventionally done by humans. Spec. ¶ 6 ("Once damage is detected during aircraft operation by means of the conventional inspection methods or through SHM systems, a technical team performs a prompt damage assessment, determining the damage severity and avoiding flight delay or cancellation whenever safely possible."). Thus, this aspect of step [5] could also be performed in the human mind and is therefore a mental step.

In the last part of step [5], the claim recites "using results of the additional specific structural analysis to automatically determine the number of flight cycles allowed before repair when the at least one processor determines a repair is needed." In other words based on the structural analysis, it is determined the number of flights cycles before a repair is needed. The claim does not describe how this determination is made. Based on the evidence in Sinex, it appears that aircraft technical documents contain such information and therefore this determination can be made by consulting such a document. Sinex 1:40–50.

In sum, steps [3] and [5] of claim 1 are abstract ideas because they can be performed in a human mind. Step [6] generates a report based on disposition determined in step [5] and is not an abstract idea.

Appellant argues that the method is not an abstract idea because it is performed automatically on a machine. Reply Br. 2.

This argument is not persuasive. The claimed method is performed on a computer "processor." While the steps are performed on a computer, this is insufficient to confer eligibility on the abstract idea. As explained in *Intellectual Ventures I LLC v. Symantec Corp*., 838 F.3d 1307, 1318 (Fed Cir. 2016, "with the exception of generic computer-implemented steps, there is nothing in the claims themselves that foreclose them from being performed by a human, mentally or with pen and paper." *See also* Eligibility Guidance, 84 Fed. Reg. 52 (n. 14). "Claims can recite a mental process even if they are claimed as being performed on a computer." October 2019 Update to Subject Matter Eligibility.[6]

In sum, for the foregoing reasons, we find that claim 1 recites an abstract idea. Accordingly, we proceed to Step 2A, Prong Two, of the Eligibility Guidance.

[6] Available at https://www.uspto.gov/sites/default/files/documents/peg_oct_2019_update.pdf (last accessed Nov. 15, 2019) ("PEG Update").

Step 2A, Prong Two

Prong Two of Step 2A under the 2019 Eligibility Guidance asks whether there are additional elements that integrate the exception into a practical application. As in the *Mayo/Alice* framework, we must look at the claim elements individually and "as an ordered combination" to determine whether the additional elements integrate the recited abstract idea into a practical application. The Eligibility Guidance explains that "[a] claim that integrates a judicial exception in a practical application will apply, rely on, or use the judicial exception in a manner that places a meaningful limit on the judicial exception, such that the claim is more than a drafting effort designed to monopolize the judicial exception." Eligibility Guidance, 84 Fed. Reg. 54. Integration into a practical application is evaluated by identifying whether there are additional elements individually, and in combination, which go beyond the judicial exception. Eligibility Guidance, 84 Fed. Reg. 54–55. Specifically, the Guidance describes several considerations in determining whether the abstract idea is integrated into a practical application:

> An additional element reflects an improvement in the functioning of a computer, or an improvement to other technology or technical field
> . . .
> an additional element implements a judicial exception with, or uses a judicial exception in conjunction with, a particular machine or manufacture that is integral to the claim
> . . .
> an additional element applies or uses the judicial exception in some other meaningful way beyond generally linking the use of the judicial exception to a particular technological environment, such that the claim as a whole is more than a drafting effort designed to monopolize the exception.

84 Fed. Reg. 55.

The PEG Update explains that "first the specification should be evaluated to determine if the disclosure provides sufficient details such that one of ordinary skill in the art would recognize the claimed invention as providing an improvement." PEG Update 12.

Appellant points to the Specification as describing the claimed invention's improvement over the prior art. Reply Br. 4–5. The Specification states that there are inefficiencies in the prior art "such as the long time spent by the airline technical team consulting the SRM [structural repair manual] and assessing the damage based on its instructions. Additionally, due to human factors, mistakes can occur during this activity resulting in an incorrect damage disposition." Spec. ¶ 12. The Specification also describes another deficiency in the prior art:

> One prior method currently used to assess the structural damage, requires that the airline technical team consults the SRM [structural repair manual] and assesses the damage based on its instructions. There can be issues in this process, such as the long time spent by the airline technical team during this activity and the mistakes that can occur, due to human factors, resulting in an incorrect damage disposition. Besides that, some prior systems do not perform structural analysis in order to improve the damage disposition or provide a rework and/or repair solution when the damage is not within the limits specified in the SRM.

Spec. ¶ 14.

The Specification describes its improvement as a "computerized and automated system specially developed in order to assess typical structural damages and repairs will lead to cost and safety benefits." Spec. ¶ 16. It explains that "structural analysis automation allows the implementation of more detailed and accurate analysis methodology that reflects the actual behavior of the damaged or repaired structure and consequently improves the damage disposition." *Id.* The Specification also discloses that its system is "able to provide electronic disposition for structural damage that occurs during the aircraft life." Spec. ¶18.

The improvements described by Appellant do not constitute a patent-eligible improvement to a technology or technical field. Eligibility Guidance, 84 Fed. Reg. 55 (reproduced above). Appellant also does not identify an improvement in the way the computer functions, in how the sensors are arranged or used to collect the data, or how the aircraft as a machine interacts with the sensor or other aspects of the claimed method. Specifically, the claims do not explain how the sensor works to collect data (step [1], how comparisons are made [3], how the structural analysis is performed (step [4]) or how the damage disposition is accomplished (step [5]). None of the steps recited in the claim explain how the desired result is achieved. Thus, the claims do not recite any of the hallmarks considered by the courts to confer eligibility to a claim reciting an abstract idea. This is explained in *McRO*, *Inc. v. Bandai Namco Games Am. Inc*., 837 F.3d 1299 (Fed. Cir. 2016).

In *McRO*, the claims were directed to a "method for automatically animating lip synchronization and facial expression of three-dimensional characters." McRO, 837 F.3d, 1307–08. The claim recited a series of steps that "produce[d] lip synchronization and facial expression control of said animated characters." *Id.* The court found that the "claimed process uses a combined order of specific rules that renders information into a specific format that is then used and applied to create desired results: a sequence of synchronized, animated characters." *McRO*, 837 F.3d at 1315. Further, the court found that the recited rules "are limiting in that they define morph weight sets as a function of the timing of phoneme sub-sequences." *McRO*, 837 F.3d at 1313. The claims were found to be directed to a "technological improvement over the existing, manual 3-D animation techniques." *McRO*, 837 F.3d at 1316.

In finding the claim patent-eligible, *McRO* noted that the "abstract idea exception has been applied to prevent patenting of claims that abstractly cover results where 'it matters not by what process or machinery the result is accomplished.' [*O'Reilly v. Morse*, 56 U.S. (15 How.) 62, 113,]; see also *Mayo*, 132 S.Ct. at 1301." *McRO*, 837 F.3d at 1314. *McRO* stated that therefore, a court must "look to whether the claims in these patents focus on a specific means or method that improves the relevant technology or are instead directed to a result or effect that itself is the abstract idea and merely invoke generic processes and machinery." *McRO*, 837 F.3d at 1314.

In this case, the steps of "comparing" and determining damage are not required by the claim to be executed in a specific manner as they were in *McRO*. The claimed steps, as a whole, recite the desired result, but not the specific rules that enable the result, which would deter preemption of the abstract idea of organizing human activity. In *McRO*, the court held that the "limitations in claim 1 prevent preemption of all processes for achieving automated lip-synchronization of 3–D characters." *McRO*, 837 F.3d at 1315. The court explained that "[t]he specific structure of the claimed rules would prevent broad preemption of all rules-based means of automating lip synchronization." *Id.* Here, the steps in rejected claim 1 are recited in such general terms that carrying out "analyzing and assessing structural damage to an aircraft during operation of the aircraft" would preempt the abstract idea embodied in the claim.

Based on the discussion in the Specification, the claimed method appears to be an improvement to the manual steps in which damage is assessed, by instead, carrying out the steps on a computer. However, simply automating a process using a computer is not sufficient to confer patent eligibility. The steps of claim 1 do not recite how the result is achieved, but rather just state that the intention of the claim is to accomplish the desired result, such as making comparisons to a structural repair manual and determining whether an aircraft is safe for flight or needs repair. The claim does not even require that repair is done to the aircraft or that the aircraft, after the analysis, is operated in-flight. Only a report is generated in the last step of the claim. Unlike in *Diamond v. Diehr*, 450 U.S. 175 (1981), where the abstract idea was used to control a physical process by determining when a compound was cured in order to automatically open the mold, the abstract ideas in claim 1 are not applied in a practical way, but rather the end result is to generate a report.

The rejected claims in this appeal have the same deficiency identified in *Apple, Inc. v. Ameranth, Inc.*, 842 F.3d 1229, 1241 (2016), which were held to be ineligible for a patent under 35 U.S.C. § 101 because they did "not claim a particular way of programming or designing the software to create menus that have these features, but instead merely claim the resulting systems." Likewise, the claims recite certain functions in steps [2]–[5], but not how the functions are accomplished. A judicial exception is not integrated into a practical application when the additional element "merely uses a computer as a tool to perform an abstract idea." 84 Fed. Reg. 55.

Step 2B

Because we determined that the judicial exception is not integrated into a practical application, we proceed to Step 2B of the Eligibility Guidelines, which asks whether there is an inventive concept. In making this Step 2B determination, we must consider whether there are specific limitations or elements recited in the claim "that are not well-understood, routine, conventional activity in the field, which is indicative that an inventive concept may be present" or whether the claim "simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exception, indicative that an inventive concept may not be present." Eligibility Guidance, 84 Fed. Reg. 56 (footnote omitted). We must also consider whether the combination of steps are performed "in an unconventional way and therefore include an 'inventive step,' rendering the claim eligible at Step 2B." *Id.* In this part of the analysis, we consider "the elements of each claim both individually and 'as an ordered combination'" to determine "whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Alice*, 573 U.S. at 217.

Appellant has not explained how the steps in the claimed method operate in an inventive way to achieve the result of generating a report as in step [6] of the claim. The sensors gather data and are used to perform structural analysis in steps [2] and [4], respectively. But Appellant did not establish that these steps cooperate with the other steps in the method to achieve the analysis and assessment of the structural damage in the aircraft. The Specification explains that the improvement is to the manual way of accomplishing this result, but the claims in automating the process are not recited with sufficient specificity and we have not been directed to how the combination performs any different from the manual process.

With respect to dependent claims 32–37 which recite specific sensor types, Appellant argues that the Examiner did not provide evidence that such claims are "not a practical implementation." Appeal Br. 6. However, there is no evidence in this record that the function or operation of the sensors improves the abstract ideas recited in claim 1. For example in *Thales Visionix, Inc. v. U.S.*, 850 F.3d 1343 (Fed. Cir. 2017), the eligibility of claims "for tracking the motion of an object relative to a moving reference frame" which comprised inertial sensors was addressed. The court found that the claims were eligible under § 101 because they "are directed to systems and methods that use inertial sensors in a non-conventional manner to reduce errors in measuring the relative position and orientation of a moving object on a moving reference frame." *Id*. at 1348. Here, Appellants did not establish that the sensors are being used non-conventionally or are arranged in a non-conventional manner to assess the aircraft damage.

For the foregoing reasons, the rejection under 35 U.S.C. § 101 of claim 1 as lacking patent eligibility is affirmed. Claim 4, 8, 10–13, 15, 16, 20, 22, 23, 24, and 30–37 were not argued separately; they consequently fall with claim 1. 37 C.F.R. § 41.37(c)(1)(iv).

CONCLUSION

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1, 10, 12, 13, 15, 22, 24, 30	103	Kent, Torng, Sinex, Cerreta, Nakagawa	1, 10, 12, 13, 15, 22, 24, 30	
4, 16	103	Kent, Torng, Sinex, Cerreta, Nakagawa, Sweeney	4, 16	
8, 20	103	Kent, Torng, Sinex, Cerreta, Nakagawa, Fields	8, 20	
11, 23	103	Kent, Torng, Sinex, Cerreta, Nakagawa, Isobe	11, 23	
31, 33,	103	Kent, Torng, Sinex, Cerreta, Nakagawa, Stothers	31, 33	
32, 35, 36	103	Kent, Torng, Sinex, Cerreta, Nakagawa, Giurgiutiu	32, 35, 36	
34	103	Kent, Torng, Sinex, Cerreta, Nakagawa, Akdeniz	34	
37	103	Kent, Torng, Sinex, Cerreta, Nakagawa, Martin	37	
1, 4, 8, 10–13, 15, 16, 20, 22, 23, 24, 30–37	101	Eligibility	1, 4, 8, 10–13, 15, 16, 20, 22, 23, 24, 30–37	

Overall Outcome			1, 4, 8, 10–13, 15, 16, 20, 22, 23, 24, 30–37	

TIME PERIOD

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED