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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/630,145	09/28/2012	Conway Chuong	67097-2153PUS1; 63773US01	8190
54549	7590	10/02/2019	EXAMINER	
CARLSON, GASKEY & OLDS/PRATT & WHITNEY 400 West Maple Road Suite 350 Birmingham, MI 48009			CROHN, MARK I	
			ART UNIT	PAPER NUMBER
			2857	
			NOTIFICATION DATE	DELIVERY MODE
			10/02/2019	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte CONWAY CHUONG

Appeal 2017-009724
Application 13/630,145
Technology Center 2800

Before CATHERINE Q. TIMM, MONTÉ T. SQUIRE, and
JEFFREY R. SNAY, *Administrative Patent Judges*.

SNAY, *Administrative Patent Judge*.

DECISION ON APPEAL¹

Appellant² appeals under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 13, 14, and 17–22. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

¹ We cite to the Specification (“Spec.”) filed September 28, 2012; Final Office Action (“Final Act.”) dated August 26, 2016; Appellant’s Appeal Brief (“Appeal Br.”) filed January 17, 2017; Examiner’s Answer (“Ans.”) dated May 5, 2017, and Appellant’s Reply Brief (“Reply Br.”) filed July 5, 2017.

² Appellant is Applicant, United Technologies Corporation, which is identified in the Appeal Brief as the real party in interest (Appeal Br. 1).

BACKGROUND

The subject matter on appeal relates to a method for calculating a throat area of a section of a gas turbine engine. Spec. ¶ 1. In operation of a gas turbine engine, combustion gases are communicated through a throat opening that extends between adjacent vanes of a vane assembly. *Id.* ¶ 4. The throat area controls the pressure ratio and mass flow rate of the engine. *Id.* According to the Specification, undulations or contouring of the vane assembly end walls can lead to invalid calculations of throat area. *Id.* ¶ 5. Appellant describes a calculation technique that is said to be useful for calculating throat area on segments of a gas turbine engine that include end wall contouring. *Id.* ¶ 47. Claim 13 is illustrative:

13. A method of calculating a throat area of a section of a gas turbine engine, comprising the steps of:
 - outlining a boundary of a throat area of the section by referencing a CAD model of the section;
 - selecting a plurality of inspection points along the boundary of the throat area;
 - measuring a location of each of the plurality of inspection points on an actual casting of the section using a coordinate measuring machine (CMM);
 - radially dividing the throat area of the section into a plurality of sections, the throat area extending between a first airfoil and a second airfoil of the section;
 - calculating an individual area associated with each of the plurality of sections of the throat area;
 - summing the individual areas of each of the plurality of sections to calculate the throat area; and
 - utilizing the calculated throat area to verify clearances in a core flow path of the gas turbine engine.

Appeal Br. 12 (Claims Appendix). Independent claim 21 recites essentially the same method as claim 13 except that the calculated area is used “to

verify a pressure ratio and a mass flow rate” associated with the throat. *Id.* at 13. Each remaining claim on appeal depends from claim 13 or 21.

REJECTIONS

- I. Claims 13, 14, and 17–22 stand rejected under 35 U.S.C. § 101 as being directed to patent-ineligible subject matter.
- II. Claims 13, 14, 17–19, 21, and 22 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Harding,³ Edwards,⁴ Grover,⁵ Omura,⁶ Cameron,⁷ and Weston.⁸
- III. Claim 20 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Harding, Edwards, Grover, Omura, Cameron, Weston, and Weideman.⁹

DISCUSSION

Rejection I

The Examiner rejects claims 13, 14, and 17–22 under 35 U.S.C. § 101 as being directed to a judicial exception—namely, an abstract idea without

³ US 2004/0239948 A1, published December 2, 2004.

⁴ C.H. Edwards, Jr. et al., *Calculus with Analytic Geometry*, 4th ed., Prentice Hall, pp. 277, 279–80, 314, 325–26.

⁵ US 2011/0236200 A1, published September 29, 2011.

⁶ George Omura et al., *Mastering AutoCAD 2013 and AutoCAD LT 2013*, Sybex (2012).

⁷ US 2009/0306930 A1, published December 10, 2009.

⁸ Weston, K.C., Energy Conservation, retrieved by Examiner from https://archive.org/stream/Energy_conservation_books/5-gasturbinesandjetengines#page/no/mode/2up (*see* Notice of Reference Cited (PTO-892) entered August 26, 2016).

⁹ Weideman, J.A.C., *Numerical Integration of Periodic Functions: A Few Examples*, *The American Mathematical Monthly*, Vol. 109, No. 1 (2002), p. 21.

significantly more. Final Act. 11. Appellant argues the claims as a group. *See* App. Br. 3–7; Reply Br. 1–3. In accordance with 37 C.F.R. § 41.37(c)(1)(iv), we select independent claim 13 as representative, and decide the appeal based on the representative claim alone. Having considered the Examiner’s findings and Appellant’s arguments, we are not persuaded the Examiner reversibly erred in rejecting claim 1 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.” 35 U.S.C. § 101. However, the Supreme Court has long interpreted 35 U.S.C. § 101 to include implicit exceptions: “[l]aws of nature, natural phenomena, and abstract ideas” are not patentable. *E.g., Alice Corp. Pty. Ltd. v. CLS Bank Int’l*, 573 U.S. 208, 216 (2014).

In determining whether a claim falls within an excluded category, we are guided by the Supreme Court’s two-step framework, described in *Mayo* and *Alice*. *Id.* at 217–18 (citing *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 75–77 (2012)). In accordance with that framework, we first determine what concept the claim is “directed to.” *See Alice*, 573 U.S. at 219 (“On their face, the claims before us are drawn to the concept of intermediated settlement, *i.e.*, the use of a third party to mitigate settlement risk.”); *see also Bilski v. Kappos*, 561 U.S. 593, 611 (2010) (“Claims 1 and 4 in petitioners’ application explain the basic concept of hedging, or protecting against risk.”).

Concepts determined to be abstract ideas, and thus patent ineligible, include certain methods of organizing human activity, such as fundamental economic practices (*Alice*, 573 U.S. at 219–20; *Bilski*, 561 U.S. at 611);

mathematical formulas (*Parker v. Flook*, 437 U.S. 584, 594–95 (1978)); and mental processes (*Gottschalk v. Benson*, 409 U.S. 63, 69 (1972)). Concepts determined to be patent eligible include physical and chemical processes, such as “molding rubber products” (*Diamond v. Diehr*, 450 U.S. 175, 191 (1981)); “tanning, dyeing, making water-proof cloth, vulcanizing India rubber, smelting ores” (*id.* at 182 n.7 (quoting *Corning v. Burden*, 56 U.S. 252, 267–68 (1853))); and manufacturing flour (*Benson*, 409 U.S. at 69 (citing *Cochrane v. Deener*, 94 U.S. 780, 785 (1876))).

In *Diehr*, the claim at issue recited a mathematical formula, but the Supreme Court held that “[a] claim drawn to subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula.” *Diehr*, 450 U.S. at 176; *see also id.* at 191 (“We view respondents’ claims as nothing more than a process for molding rubber products and not as an attempt to patent a mathematical formula.”). Having said that, the Supreme Court also indicated that a claim “seeking patent protection for that formula in the abstract . . . is not accorded the protection of our patent laws, . . . and this principle cannot be circumvented by attempting to limit the use of the formula to a particular technological environment.” *Id.* (citing *Benson* and *Flook*); *see, e.g., id.* at 187 (“It is now commonplace that an *application* of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection.”).

If the claim is “directed to” an abstract idea, we turn to the second step of the *Alice* and *Mayo* framework, where “we must examine the elements of the claim to determine whether it contains an ‘inventive concept’ sufficient to ‘transform’ the claimed abstract idea into a patent

eligible application.” *Alice*, 573 U.S. at 221 (quotation marks omitted). “A claim that recites an abstract idea must include ‘additional features’ to ensure ‘that the [claim] is more than a drafting effort designed to monopolize the [abstract idea].’” *Id.* (quoting *Mayo*, 566 U.S. at 77). “[M]erely requir[ing] generic computer implementation[] fail[s] to transform that abstract idea into a patent-eligible invention.” *Id.*

The PTO recently published revised guidance on the application of § 101. *See Revised Patent Subject Matter Eligibility Guidance*, 84 Fed. Reg. 50 (Jan. 7, 2019) (“Guidance”). Under Step 1 of the Guidance, we determine whether the claimed subject matter falls within the four statutory categories: process, machine, manufacture, or composition of matter. Step 2A of the Guidance is two-pronged, under which we look to whether the claim recites:

- (1) any judicial exception, including certain groupings of abstract ideas (i.e., mathematical concepts, certain methods of organizing human activity such as a fundamental economic practice, or mental processes); and
- (2) additional elements that integrate the judicial exception into a practical application (*see* MPEP § 2106.05(a)–(c), (e)–(h)).

Only if a claim (1) recites a judicial exception and (2) does not integrate that exception into a practical application, do we then, under Step 2B, look to whether the claim:

adds a specific limitation beyond the judicial exception that is not “well-understood, routine, conventional” in the field (*see* MPEP § 2106.05(d)); or simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exception. *See* Guidance.

We have considered the Examiner’s findings and the Appellant’s arguments in light of the controlling case-law and Guidance, and are not persuaded the Examiner erred in rejecting the claims under 35 U.S.C. § 101.

Guidance Step 1

There is no dispute that claim 13 is within a statutory category. Claim 1 recites a method.

Guidance Step 2A, Prong 1

Under Step 2A of the Guidance, we first consider whether the Examiner erred in determining that the claim recites a judicial exception. The Examiner determined that claim 1 recites an abstract idea. Final Act. 11–12. For the reasons explained below, we see no error in that determination.

The Guidance identifies mental processes as one of the enumerated groupings of abstract ideas. A claim recites a mental process when it encompasses acts people can perform using their minds or pen and paper. *See, e.g., CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1372–3 (Fed. Cir. 2011) (determining that a claim whose “steps can be performed in the human mind, or by a human using a pen and paper” is directed to an unpatentable mental process). This is true even if the claim recites use of a generic computer component to perform the process steps. *See, e.g., Versata Dev. Grp., Inc. v. SAP Am., Inc.*, 793 F.3d 1306, 1335 (Fed. Cir. 2015) (“Courts have examined claims that required the use of a computer and still found that the underlying, patent-ineligible invention could be performed via pen and paper or in a person’s mind.”); *see also* 2019 Eligibility Guidance

84 Fed. Reg. at 52 n.14 (“If a claim, under its broadest reasonable interpretation, covers performance in the mind but for the recitation of generic computer components, then it is still in the mental process category unless the claim cannot practically be performed in the mind.”).

In this case, claim 13 recites “calculating an individual area associated with each of the plurality of sections of the throat area.” The claim does not require any particular machine or device in connection with the calculating step. A person could perform the step entirely in the mind by looking at throat dimensions and mentally calculating the associated area, and/or using pen and paper. *See, e.g.*, Spec. ¶ 53 (“For example, each shape may be one in which an area of the shape can be easily mathematically calculated.”). Thus, in the context of claim 13, the step of “calculating” can reside solely within a human thought process. Accordingly, we conclude that claim 13 recites a mental process, which is identified in the Guidance as an abstract idea.

Guidance Step 2A, Prong 2

Having determined that the claims recite a judicial exception, our analysis under the Guidance turns to determining whether there are additional elements that integrate the exception into a practical application. *See* MPEP § 2106.05(a)–(c), (e)–(h). The additional elements in claim 13 are: (1) “outlining a boundary . . . by referencing a CAD model” (2) “selecting a plurality of inspection points;” (3) “measuring a location of each of the plurality of inspection points . . . using a coordinate measuring machine;” (4) “radially dividing the throat area into a plurality of sections;”

(5) “summing the individual areas;” and (6) “utilizing the calculated throat area to verify clearances.”

We determine that claim 13 does not recite additional elements that integrate the judicial exception into a practical application. The recited “outlining,” “selecting,” “measuring,” and “dividing” steps involve data gathering recited at a high level of generality. *See Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1354 (Fed. Cir. 2016); *see also SAP Am., Inc. v. InvestPic, LLC*, 898 F.3d 1161, 1168 (Fed. Cir. 2018) (“As many cases make clear, even if a process of collecting and analyzing information is ‘limited to particular content’ or a particular ‘source,’ that limitation does not make the collection and analysis other than abstract.” (quoting *Elec. Power Grp.*, 830 F.3d at 1353, 1355 (citing cases))). In this case, the foregoing steps, both individually and collectively, merely constitute identification and collection of throat section dimensions to be used in the recited calculation. “Summing” the calculated individual areas can be performed in a person’s mind or with pen and paper using mathematical techniques. As such, the summing step also does not “transform the nature of the claim into a patent-eligible application.” *See Alice*, 573 U.S. at 217; *see also* Guidance 84 Fed. Reg. at 55 n.24 (“USPTO guidance uses the term ‘additional elements’ to refer to claim features, limitations, and/or steps that are recited in the claim *beyond the identified judicial exception.*”).

Appellant argues that the claims are not directed to an abstract idea because “[t]he focus of the subject claims is on improving gas turbine engine efficiency by verifying and controlling clearances in a core flow path.” Appeal Br. 4. However, neither efficiency improvement nor clearance control is recited in the claim. Although claim 13 recites “utilizing the

calculated throat area to verify clearances,” Appellant does not explain how that recitation requires anything more than comparing the calculated value with a reference value for verification. *See* Spec. ¶ 46 (“The throat area 66 of the vane segment 50 is an important parameter that may influence engine efficiency. Therefore, the throat area 66 must be periodically measured and calculated to verify clearances in the core flow path C.”). Verification by comparing a calculated value to a reference can be performed in a person’s mind and, therefore, does not “transform the nature of the claim into a patent-eligible application.” *See Alice*, 573 U.S. at 217; *see also* Guidance 84 Fed. Reg. at 55 n.24.

Appellant also argues that the claims on appeal are “[l]ike the claims involved in *Diamond v. Diehr*” because Appellant’s claims are “part of a detailed process for improving gas turbine engine efficiency.” Appeal Br. 5. Appellant similarly argues the claims in this appeal are distinguishable from those at issue in *Electric Power Group* on the basis that Appellant’s claims “are directed to a gas turbine engine method that uses a mathematical equation as part of a detailed process for improving gas turbine engine efficiency.” *Id.* at 6. Appellant’s arguments are not persuasive of reversible error in the Examiner’s rejection because claim 13 lacks any recitation of improving engine efficiency or any other recitation that would require practical application of the recited calculation.

Viewed as a whole, the claim applies mental processes to the environment of determining the area of a throat opening in a gas turbine engine. “[M]erely limiting the field of use of the abstract idea to a particular existing technological environment does not render the claims any less abstract.” *Affinity Labs of Texas, LLC v. DIRECTV, LLC*, 838 F.3d 1253,

1259 (Fed. Cir. 2016). We are not persuaded that the claimed method effects an improvement in computer-technology or any other technology or technical field. *See* MPEP § 2106.05(a).

Nor does the claimed method apply the judicial exception using any particular machine. *See* MPEP § 2106.05(b). Claim 13 recites only a generic “coordinate measuring machine.” Appellant does not purport that the claim adds any other meaningful (technological) limitation, i.e., limitations beyond linking the use of the abstract idea to generic technology. *See* MPEP § 2106.05(c), (e); *see also id.* at (f)–(h) (mere instruction to apply a judicial exception (f), insignificant extra-solution activity (g), and generally indicating a field of use or technological environment in which to apply a judicial exception (h), are insufficient to integrate an abstract idea into a practical application).

For the foregoing reasons, we determine that claim 13 does not integrate the judicial exception into a practical application.

Guidance Step 2B

In *Alice* step two, we consider the elements of the claim, both individually and as an ordered combination, to assess whether the additional elements transform the nature of the claim into patent-eligible subject matter. *Content Extraction & Transmission LLC v. Wells Fargo Bank*, 776 F.3d 1343, 1347 (Fed. Cir. 2014). “To save a patent at step two, an inventive concept must be evident in the claims.” *RecogniCorp, LLC v. Nintendo Co.*, 855 F.3d 1322, 1327 (Fed. Cir. 2017). “An inventive concept that transforms the abstract idea into a patent-eligible invention must be significantly more than the abstract idea itself, and cannot simply be an

instruction to implement or apply the abstract idea on a computer.” *Bascom Global Internet Servs., Inc. v. AT&T Mobility LLC*, 827 F.3d 1341, 1349 (Fed. Cir. 2016). According to the Guidance, “simply append[ing] well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality,” is indicated that an inventive concept is absent. Guidance, 84 Fed. Reg. at 56.

In this context, we also look to see if the additional elements are more than “well-understood, routine, and conventional” so as to amount to an inventive concept. Conversely, we consider whether these additional elements simply append “well-understood, routine, and conventional” elements, particularly at a high level of generality, to the judicial exception.

Appellant does not point to evidence of record that would tend to show that the step of “calculating” area in claim 13 is more than well-understood, routine, and conventional. To the contrary, Edwards serves as evidence that area calculation through application of a Riemann Sum was, indeed, well-known. *See, e.g.*, Edwards Fig. 5.8.3. The recited steps of outlining a boundary and selecting and measuring inspection points would have been well-understood aspects routinely performed in connection with the Riemann Sum technique. *See id.* Appellant does not contend that the recited use of a CAD model or generic coordinate measuring machine for that purpose were other than conventional devices used in their customary manner. The remaining steps of sectioning the bounded area and summing calculated areas of individual sections can be performed as mental processes and, therefore, also are abstract ideas. When considered as an ordered combination, the steps recited in claim 13 essentially apply a known

mathematical relationship between the boundary contours of an opening to determine the area of a throat in a gas turbine engine.

For the foregoing reasons, we determine that the additional elements recited in claim 13 do not amount to significantly more than the abstract idea itself.

For the reasons discussed above and by the Examiner, we are not persuaded of reversible error in the Examiner's rejection of representative claim 13. Accordingly, the rejection of claims 13, 14, and 17–22 under 35 U.S.C. § 101 is sustained.

Rejection II

The Examiner also rejects claims 13, 14, 17–19, 21, and 22 under 35 U.S.C. § 103(a) as unpatentable over Harding, Edwards, Grover, Omura, Cameron, and Weston (Rejection II). Final Act. 13.

With regard to Rejection II, Appellant argues the claims as a group, focusing on recitations found in independent claims 13 and 21. *See* Appeal Br. 7–9. Appellant separately presents additional arguments for claims 19 and 21. *Id.* at 9–10. We, therefore, limit our discussion to the independent claims and separately argued claim 19. Each remaining claim subject to this rejection stands or falls with the independent claim from which it depends. 37 C.F.R § 41.37(c)(1)(iv).

Relevant to Appellant's arguments on appeal, the Examiner finds that Harding discloses a method for determining throat area within an optically determined boundary of a gas turbine engine section, but fails to teach referencing a CAD model of the section or calculating area using the recited dividing and summing technique. Final Act. 13–14. The Examiner finds

that Omura provides a reason to use a CAD model in aid of defining a throat boundary in Harding. *Id.* at 15. The Examiner further finds that Edwards discloses a known mathematical technique, identified as a Riemann sum, for calculating the area of a region, which would have been recognized as useful in Harding to perform the desired throat area calculation. *Id.* at 14–17.

Appellant argues Harding requires use of a sophisticated optical sensor system for measuring a throat opening area, and “using a Riemann Sum would completely obviate the invention of Harding” because it would “render the optical sensor system of Harding unnecessary.” Appeal Br. 8–9. Appellant also argues that “outlining a boundary of a throat area in a CAD program” or measuring inspection points using a coordinate measuring machine would be “redundant or completely unnecessary given the capabilities of Harding’s optical sensor system.” Appeal Br. 8–9.

Appellant’s arguments are not persuasive of reversible error in the Examiner’s rejection. As the Examiner explains, using a Riemann sum technique to calculate area “merely fills in a step in Harding’s process which Harding is silent on.” Ans. 24. Particularly, Harding teaches that the illuminated area is calculated by an image processor, but does not specify any calculation technique. *See* Harding ¶ 22. Appellant does not persuasively explain why adopting Edward’s calculation technique would obviate Harding’s optical system. Nor does Appellant persuasively explain why referencing a CAD model in connection with identifying a throat area boundary would have been redundant in Harding. As Appellant acknowledges (Reply Br. 4), Harding teaches use of alignment and calibration information to determine coordinates that are within the intended boundary. *See* Harding ¶ 22 (“The image processor extracts two-

dimensional information from the digitized image, and using alignment and calibration information accessible to the image processor, determines the coordinates that are within the received boundary.’’). The Examiner’s proffered evidence of using CAD programming to outline a boundary of interest is consistent with Harding’s need for alignment and calibration information. Regarding the recited use of a coordinate measuring machine, Appellant does not challenge the Examiner’s finding that Harding’s optical system meets that recitation. *Compare* Ans. 23 (finding that Harding’s optical measurement system “falls within the scope of the term CMM”) *with*, Reply Br. 3–5.

Appellant also argues that Edwards fails to teach selecting inspection points, and Grover lacks any teaching of a throat area. Appeal Br. 9. However, as the Examiner explains (Ans. 26), Edwards shows selected inspection points labeled $x_1 \dots x_n$. *See* Edwards Fig. 5.4.1. The Examiner relies on Grover to illustrate that a gas flow path occurs within a vane segment section of a gas turbine engine. Final Act. 18. Harding, not Grover, is relied upon for identifying and measuring a throat area within such a section.

Claim 19 additionally recites that the section in which the measured throat is located includes “an end wall having at least one undulation.” Appellant argues “there is no teaching or suggestion in any of the asserted references for utilizing a calculated throat area to verify clearances or specifically a pressure ratio and mass flow rate associated with an end wall contoured flow path.” Appeal Br. 9. However, the Examiner finds that Harding teaches that the throat area perimeter can be defined by “curved or wavy lines due to design complexity and/or part distortion during use.”

Final Act. 21 (quoting Harding 15:24–26). Appellant’s argument neither addresses nor persuasively shows error in the Examiner’s finding.

With regard to claim 21, Appellant contends the Examiner improperly takes official notice of a scientific principle that pressure ratio and mass air flow are dependent upon throat area. Appeal Br. 9–10. The Examiner points to evidence of record—namely, Weston—as evidence of the principle. Ans. 27–28. Appellant does not challenge that evidence in the Reply Brief. As such, Appellant’s contention is not persuasive of improper reliance on official notice.

For the foregoing reasons, Appellant does not persuasively show reversible error in the Examiner’s § 103(a) rejection of claims 13, 14, 17–19, 21, and 22. Rejection II is sustained.

Rejection III

The Examiner adds Weideman to reject claim 20 (Rejection III). Claim 20 depends from claim 13 and adds a step of “adjusting the throat area calculation based on an error value associated with a trailing edge location of the section.” The Examiner relies on Weideman as evidence of generally applying error values when applying a Riemann Sum technique to perform an area calculation. Final Act. 25. Appellant argues that Weideman is directed to numerical integration of periodic functions and “has nothing to do with the error associated with a throat area calculation in a gas turbine engine.” Appeal Br. 10.

Appellant’s argument is not persuasive of reversible error. Weideman expressly teaches use of a graphed boundary function “to estimate the error” in performing a Riemann Sum technique for calculating a bounded area.

Weideman, 21. Appellant's argument that Weideman does not pertain to throat area calculation in a gas turbine engine does not negate Weideman's teaching of applying an error factor when performing a Reimann Sum. Nor does it refute the Examiner's finding that the relied-upon prior art would have provided a reason to apply such a Riemann Sum technique to the calculation of a gas turbine engine throat area defined in part by a trailing edge.

Rejection III is, therefore, sustained.

CONCLUSION

The Examiner's rejection of claims 13, 14, and 17–22 under 35 U.S.C. § 101 is sustained.

The Examiner's rejection of claims 13, 14, and 17–19, 21, and 22 under 35 U.S.C. § 103(a) is sustained.

The Examiner's rejection of claim 20 under 35 U.S.C. § 103(a) is sustained.

DECISION

The Examiner's decision rejecting claims 13, 14, and 17–22 is affirmed.

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

AFFIRMED