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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte FREDERICK M. SCHWARZ and WILLIAM K. ACKERMANN

Appeal 2020-000562
Application 14/751,274
Technology Center 3700

Before JOHN C. KERINS, MICHELLE R. OSINSKI, and
WILLIAM A. CAPP, *Administrative Patent Judges*.

CAPP, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant¹ seeks our review under 35 U.S.C. § 134(a) of the final rejection of claims 1–23. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

¹ We use the word “Appellant” to refer to “applicant” as defined in 37 C.F.R. § 1.42(a). Appellant identifies United Technologies Corporation as the Applicant and real party in interest. Appeal Br. 1.

THE INVENTION

Appellant's invention relates to gas turbine engines. Spec. ¶ 2.

Claim 1, reproduced below, is illustrative of the subject matter on appeal.

1. A turbine section for a gas turbine engine comprising:

a fan drive turbine including a fan drive duct, the fan drive turbine being configured to drive a fan section through a geared architecture at a speed that is less than an input speed to the geared architecture;

at least one upstream turbine configured to drive at least one compressor, the at least one upstream turbine including a turbine duct defining a conical flow path having a conical inlet defined by a first diameter and a conical outlet defined by a second diameter greater than the first diameter, the conical outlet being in fluid communication with the fan drive duct downstream of the conical outlet; and

at least one row of shrouded rotor blades defining at least a portion of the conical flow path.

THE REJECTIONS

The Examiner relies upon the following as evidence in support of the rejections:

NAME	REFERENCE	DATE
Klees	US 3,792,584	Feb. 19, 1974
Pearson	US 3,876,330	Apr. 8, 1975
Waters	Non-Patent Literature	Jan. 1977
Seda	US 2003/0163983 A1	Sept. 4, 2003
Warwick	Non-Patent Literature	Nov. 30, 2007
Schilling	US 2008/0022653 A1	Jan 31, 2008
Somanath	US 2008/0056904 A1	Mar. 6, 2008
Norris	US 2011/0056208 A1	Mar. 10, 2011
Sharma	US 2012/0174593 A1	July 12, 2012
Vetters	US 2014/0363276 A1	Dec. 11, 2014

The following rejections are before us for review:

1. Claims 13, 16, 19, and 22 are rejected under 35 U.S.C. § 112(a) as failing to comply with the written description requirement.
2. Claims 13, 16, and 22 are rejected under 35 U.S.C. § 112(a) as failing to comply with the enablement requirement.
3. Claims 1–4, 9–11, and 18 are rejected under 35 U.S.C. § 103 as being unpatentable over Sharma and Pearson.
4. Claims 5, 8, 12–17, and 21 are rejected under 35 U.S.C. § 103 as being unpatentable over Sharma, Pearson, Vettters, Norris, Seda, and Waters.
5. Claims 6 and 7 are rejected under 35 U.S.C. § 103 as being unpatentable over Sharma, Pearson, Vettters, Norris, Somanath, Seda, and Waters.
6. Claim 22 is rejected under 35 U.S.C. § 103 as being unpatentable over Sharma, Pearson, Vettters, Norris, Seda, Waters, and Schilling.
7. Claims 19 and 20 are rejected under 35 U.S.C. § 103 as being unpatentable over Sharma, Pearson, Klees, and Warwick.
8. Claim 23 is rejected under 35 U.S.C. § 103 as being unpatentable over Sharma, Pearson, Klees, Warwick, Vettters, Norris, Seda, and Waters.

OPINION

Claim 13

Section 112 Written Description and Enablement

Claim 13 depends directly from claim 12 which, in turn, depends from independent claim 9 and adds the limitation: “wherein the geared architecture defines a gear reduction ratio greater than or equal to 2.3.” Claims App. The Examiner essentially takes the position that Appellant’s disclosure fails to demonstrate possession of an invention that encompasses

the upper end of Appellant's open-ended claim language. Final Act. 2–5. The Examiner similarly takes the position that achieving the upper end of such open-ended gear reduction ratio range is not enabled.

Appellant argues that claim 13 implicitly discloses an upper limit that is inherent. Appeal Br. 11, 16. Appellant assigns to the Examiner the burden of establishing whether there is an inherent upper limit to the claimed range. *Id.* at 11.

In response, the Examiner states that Appellant's alleged inherent limit amounts to unsubstantiated attorney argument. Ans. 26, 28. In reply, Appellant argues that the Examiner's "inherent" limit position is improper. Reply Br. 10.

Open-ended claims are not inherently improper. *Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361, 1376 (Fed. Cir. 2007). Their appropriateness depends on the particular facts of the invention, the disclosure, and the prior art. *Id.* They may be supported if there is an inherent, albeit not precisely known, upper limit and the specification enables one of skill in the art to approach that limit. *Scripps Clinic & Research Found. v. Genentech, Inc.*, 927 F.2d 1565, 1572 (Fed. Cir. 1991).

In the rejection, the Examiner chronicles the historical development of gear reduction ratios in gas turbine turbofan engines. Final Act. 3–4. The Examiner cites several references, none of which are challenged by Appellant, to show that advancement in gear reduction ratios has historically taken long periods of time and hundreds of millions of dollars in research and development. *Id.*

We can accept, for argument sake, that there may be an inherent upper limit for turbofan gear reduction ratios that is represented by some number

less than infinity. We confess that we do not know whether this number is 5 or 10 or 20. However, whatever finite number we select that is greater than, say, 5, there is nothing in Appellant's disclosure that has been brought to our attention that demonstrates that Appellant has possession of such an invention or that Appellant provides an enabling disclosure for how to at least approach such inherent, albeit not precisely known, upper limit.

Scripps Clinic, 927 F.2d at 1572. To be enabling, a patent's specification must "teach those skilled in the art how to make and use the full scope of the claimed invention without 'undue experimentation.'" *ALZA Corp. v. Andrx Pharm., LLC*, 603 F.3d 935, 940 (Fed. Cir. 2010). Here, the "full scope" of the invention necessarily entails how to approach the inherent, albeit not precisely known, open-ended upper limit on gear reduction ratio. Given the relatively slow and costly rate of advancement in this area of technology, we are inclined to agree with the Examiner that the amount of experimentation necessary to make future technological advancement in gear reduction ratio should be considered "undue" in view of Appellant's lack of detailed teaching disclosure in the Specification.

Finally, Appellant's attempt to place the burden of proof on the Examiner to affirmatively demonstrate lack of written description support is contrary to applicable law. It is well settled that when a written description cannot be found in Appellant's disclosure, the only thing the PTO can reasonably be expected to do is to point out its non-existence. *Hyatt v. Dudas*, 492 F.3d 1365, 1370 (Fed. Cir. 2007). If Appellant maintains that its disclosure provides written description support, the onus is on Appellant to establish such. *Id.* The Examiner's approach to the rejection comports with applicable law. *Id.*

In view of the foregoing discussion, we sustain the Examiner's Section 112 written description rejection as well as the Examiner's Section 112 enablement rejection of claim 13.

Claims 16 and 22
Section 112 Written Description and Enablement

Claim 16 depends from claim 14 and indirectly from independent claim 9 and adds the limitation:

wherein the fan is configured to deliver a portion of air into the compressor section, and a portion of air into a bypass duct, and wherein a bypass ratio, which is defined as a volume of air passing to the bypass duct compared to a volume of air passing into the compressor section, being greater than or equal to 12.

Claims App. Claim 22 similarly has a limitation directed to a bypass ratio that is greater than or equal to 12. *Id.* The Examiner determines that Appellant's disclosure fails to provide written description support and an enabling disclosure for bypass ratios in accordance with the open-ended upper limit of the claimed range. As with the gear reduction ratio limitation in claim 13, the Examiner chronicles the historical development of by-pass ratios in turbofan engines. Final Act. 6–7 (citing literature). The literature cited by the Examiner strongly suggests that technological progress in increasing turbofan by-pass ratios is both slow and expensive. *Id.*

Appellant's arguments, and the Examiner's responses thereto, are reminiscent of their respective positions taken with regard to the open-ended upper limit of the gear reduction ratio discussed above with respect to claim 13. We reach a similar result here for essentially the same reasons.

We sustain the Section 112 written description and the Section 112 enablement rejections of claims 16 and 22.

Claim 19
Written Description

Claim 19 depends from claim 18 and adds the following limitations:

providing a fan drive blade in a first stage of the fan drive turbine, the fan drive blade including a tip, the fan drive turbine defining a fan drive radius R_{FDT} between a fan drive axis of the fan drive turbine and the tip of the fan drive blade; and

configuring the at least one row of shrouded rotor blades to be located in a last stage of the at least one upstream turbine, each of the shrouded rotor blades including a base, the at least one upstream turbine defining a turbine radius R_T between a turbine axis of the at least one upstream turbine and the base of one of the shrouded rotor blades; and

selecting each of the fan drive radius R_{FDT} and the turbine radius R_T based on the gear reduction ratio.

Claims App. (emphasis added). The Examiner determines that Appellant fails to properly disclose a relationship between the gear reduction ratio and the two claimed radii for the selecting process step. Final Act. 7. According to the Examiner, Appellant is claiming a process step without explaining how one would perform the step. *Id.*

Appellant argues that paragraphs 63, 67, and 69 and Figure 9 of Appellant's disclosure provide written description support for the "selecting" step. Appeal Br. 16.

In response, the Examiner summarizes the teaching of the recited passages in Appellant's disclosure and then states:

One would not know how the Appellant selects an upstream turbine radius based on a specified the gear reduction ratio as claimed by reviewing the disclosure. Appellant is essentially claiming a mathematical formula where a number, the gear reduction ratio, is input and two variables, the fan drive radius and the turbine radius, are output without disclosing the mathematical formula itself. To reproduce the claimed process

of claim 19, one must make up their own formula to select an upstream turbine radius from a given gear reduction ratio in order to perform the ‘selecting’ step.

Ans. 27.

In reply, Appellant argues that the Examiner fails to cite to any case law that supports the position that Appellant must provide a mathematical formula. Reply Br. 11.

Appellant’s argument that the Examiner does not cite case law for the general proposition that an applicant must always provide a mathematical formula for relationships between all claim variables does not persuade us that Appellant has possession of the claimed subject matter. Appellant does not deny that two different drive radius output parameters are derived from (or “based on”) a single input parameter (gear reduction ratio). Appellant provides no explanation as to how this is achieved or how a person of ordinary skill in the art would be able to accomplish such. *Hyatt v. Dudas*, 492 F.3d at 1370 (explaining that when a written description cannot be found in Appellant’s disclosure, the only thing the PTO can reasonably be expected to do is to point to its non-existence).

We sustain the Examiner’s Section 112 written description rejection of claim 19.

*Unpatentability of Claims 1–4, 9–11, and 18
over Sharma and Pearson*

Appellant argues claims 1–4, 9–11, and 18 as a group. Appeal Br. 3–5. Claim 1 is representative. *See* 37 C.F.R. § 41.37(c)(1)(iv).

The Examiner finds that Sharma discloses the invention substantially as claimed except for shrouded rotor blades, for which the Examiner relies on Pearson. Final Act. 16–17. The Examiner concludes that it would have

been obvious to a person of ordinary skill in the art at the time of the invention to use shrouded blades in Sharma. *Id.* at 17. According to the Examiner, a person of ordinary skill in the art would have done this to limit leakage at the blade tips and increase the efficiency of the turbine. *Id.*

Appellant first argues that Pearson lacks: (1) both an upstream turbine and a fan drive turbine; and (2) a geared architecture. Appeal Br. 4. This argument is unpersuasive as the Examiner relies on Sharma for such features. Ans. 30–31. Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

Appellant next argues that the Examiner fails to establish that one would have used shrouded blades in Sharma. Appeal Br. 4. Appellant argues that shrouds add weight and that such a weight increase goes against conventional wisdom held by engine designers. *Id.*

In response, the Examiner acknowledges that using shrouded turbine blades adds weight and that added weight is generally undesirable. Ans. 32. However, the Examiner points out that, as in almost every product design scenario, potential disadvantages of any course of action are weighed against potential advantages that may be obtained. *Id.* at 33. The Examiner observes that Pearson, despite incurring a weight penalty, nevertheless uses shrouded blades to gain the advantage of reduced leakage and increased turbine efficiency. *Id.* “Pearson weighed the advantage against the disadvantage and designed an engine with the shrouded turbine blades.” *Id.*

In reply, Appellant essentially argues that Pearson fails to explicitly discuss the design tradeoffs mentioned by the Examiner in the Answer. Reply Br. 3.

Sharma discloses a turbofan engine used for aircraft propulsion. Sharma ¶ 26. Sharma's engine features fan section 107, low pressure compressor 111, high pressure compressor 113, combustor 115, high pressure turbine 117, low pressure turbine 119, and exhaust nozzle 121. *Id.* ¶¶ 26–30. Low pressure turbine 119 drives fan section 107 through gear train 109. *Id.* ¶ 28. The diameter of low pressure turbine 119 is larger than the diameter of high pressure turbine 117. The change in diameter is gradual so as to create a conical transition from upstream high pressure turbine 117 to downstream low pressure turbine 119.

Pearson discloses the use of shrouded turbine blades in a gas turbine engine. Pearson col. 3, l. 1 – col. 4, l. 57. Pearson issued in April 1975 and is based on a foreign priority application filed in the United Kingdom in 1972. Pearson thus demonstrates that it was known to use shrouded turbine blades in gas turbine engines used for aircraft propulsion more than 40 years before the filing date of the application on appeal.

The Examiner uses a correct analysis on the relative advantages and disadvantages of particular design features, such as using shrouded turbine blades. *See Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (explaining that a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine). “The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another.

Instead, the benefits, both lost and gained, should be weighed against one another.” *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000).

Appellant’s argument that a person of ordinary skill in the art would not have been motivated to combine the teachings of Sharma and Pearson is not persuasive. Appeal Br. 5. The obviousness inquiry requires a determination that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so. *Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1360 (Fed. Cir. 2012). However, it is well established that 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. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 420 (2007). It almost goes without saying that, if a person of ordinary skill in the art would never have a reason to use shrouded turbine blades due to increased weight, Appellant would not have had any reason to use, much less claim, shrouded turbine blades. *Id.*

In the instant case, the Examiner finds that a person of ordinary skill in the art would have used shrouded rotor blades, as taught by Pearson, in Sharma’s engine to limit leakage at the blade tips and increase the efficiency of the turbine. Final Act. 17. This finding is supported by sound technical reasoning and is adequate to support the rejection. *See In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring an obviousness conclusion to be based on explicit articulated reasoning with rational underpinning) cited with approval in *KSR*, 550 U.S. at 418. Appellant provides neither evidence nor

persuasive technical reasoning that modifying Sharma to use shrouded turbine blades requires more than ordinary skill or produces unexpected results.

The Examiner's findings of fact are supported by a preponderance of the evidence and the Examiner's legal conclusion of unpatentability is well-founded. Accordingly, we sustain the Examiner's unpatentability rejection of claims 1–4, 9–11, and 18.

*Unpatentability of Claim 5, 8, 12–17, and 21
over Sharma, Pearson, Vettters, Norris, Seda, and Waters*

Claims 5, 8, 12, and 14

Claims 5 and 8 depend from claim 1 and claims 12 and 14 depend from independent claim 9. Claims App. Appellant argues them as a group. Appeal Br. 6–8. Claim 5 is representative (37 C.F.R. § 41.37(c)(1)(iv)), and adds the following limitations:

a last row of shrouded rotor blades positioned in a last stage of the at least one upstream turbine, each of the last row of shrouded rotor blades defining a trailing edge;

at least one fan drive blade positioned in a first stage of the fan drive turbine, the at least one fan drive blade defining a leading edge and a tip, the fan drive turbine defining a fan drive radius R_{FDT} between a turbine axis of the fan drive turbine and the tip of the fan drive blade; and

a transition duct fluidly coupling the turbine duct and the fan drive duct, the transition duct extending axially a transition duct length L_{TD} defined between the trailing edge of the last row of shrouded rotor blades and the leading edge of the at least one fan drive blade;

wherein a dimensional relationship of the L_{TD}/R_{FDT} is between 0.05 and 0.8.

Claims App.

The Examiner acknowledges that Sharma and Pearson do not explicitly teach a dimensional relationship of the transition duct length to fan drive radius between 0.05 and 0.8. Final Act. 22. Nevertheless, the Examiner determines that the transition duct length is a result effective variable. *Id.* at 23. Implicit in the Examiner’s rejection is the notion that optimizing such a result effective variable requires only ordinary skill and is, therefore, obvious. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012), quoting *In re Aller*, 220 F.2d 454, 456 (CCPA 1955) (“[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation”).

In traversing the rejection, Appellant first relies on the arguments that we considered and found unpersuasive with respect to claim 1, which arguments are no more persuasive here. Appeal Br. 6.

Appellant next argues that the Examiner fails to establish that “the claimed ratios” are recognized in the art as result effective variables. Appeal Br. 6 (citing *In re Antonie*, 559 F.2d 618, 620 (CCPA 1977)). According to Appellant, “the rejection does not point to any of the cited references teaching a relationship between transition duct length and turbine exit diameter or between transition duct length and fan tip diameter, or keeping a ratio of the two within any particular range.” Appeal Br. 7.

Appellant’s argument is not persuasive. It is well settled that recognition in the prior art that a property is affected by a variable is sufficient to find the variable result-effective. *Applied Materials*, 692 F.3d at 1297. Here, the Examiner provides persuasive evidence that transition duct length, core cowl length, low pressure shaft length, and turbine exit

diameter are all known to effect engine weight and performance. Final Act. 23–24. Appellant’s claimed ratios merely represent the relationship between multiple result effective variables. The mere fact that multiple result effective variables are combined does not necessarily render their combination beyond the capability of a person having ordinary skill in the art. *Applied Materials*, 692 F.3d at 1298. Although optimizing a result-effective variable may be patentable if the claimed ranges are critical and produce a new and unexpected result that is different in kind and not merely in degree from the results in the prior art, Appellant here provides no such evidence. *Id.* at 1297. “[A] claim to a product does not become nonobvious simply because the patent specification provides a more comprehensive explication of the known relationships between the variables and the affected properties.” *Id.*

In view of the foregoing discussion, we determine the Examiner’s findings of fact are supported by a preponderance of the evidence and that the Examiner’s legal conclusion of unpatentability is well-founded. We sustain the Examiner’s unpatentability rejection of claims 5, 8, 12 and 14.

Claim 21

Claim 21 depends directly from claim 15 and indirectly from independent claim 9 and adds the following limitations:

the compressor section includes a first compressor and the at least one compressor, the fan drive turbine configured to drive the first compressor;

an outer surface of the turbine duct includes a first sealing feature and each of the at least one row of shrouded rotor blades includes a second sealing feature, the first sealing feature and the second sealing feature cooperating together to define a labyrinth seal; and

the at least one row of shrouded rotor blades includes *two rows of shrouded rotor blades*.

Claims App. (emphasis added). Appellant argues that Pearson teaches only one, but not two, rows of shrouded turbine blades. Appeal Br. 9.

In response, the Examiner states that Sharma is relied on as teaching two rows of rotor blades and that Pearson is merely relied on as teaching that the blades can be shrouded. Ans. 36.

In reply, Appellant reiterates that Pearson fails to disclose that it was known to shroud a second row of turbine blades. Reply Br. 5.

Appellant's argument is not persuasive. Pearson teaches shrouded turbine blades. Sharma teaches multiple rows of turbine blades. Appellant identifies no technological hurdles that needed to be overcome to shroud a second row of turbine blades. Appellant provides neither evidence nor persuasive technical reasoning that shrouding a second row of turbine blades requires more than ordinary skill or produces unexpected results.

We sustain the Examiner's unpatentability rejection of claim 21.

Claims 13 and 15–17

These claims all depend indirectly from independent claim 9. Claims App. Appellant does not argue for their separate patentability apart from arguments presented with respect to claims 1 and 9 which we have previously considered. We sustain the Examiner's rejection of claims 13 and 15–17. *See* 37 C.F.R. § 41.37(c)(1)(iv) (failure to separately argue claims constitutes a waiver of arguments for separate patentability).

*Unpatentability of Claims 6, 7, 19, 20, 22, and 23
 over Combinations Based on Sharma and Pearson*

These claims are not separately argued. Appeal Br. 9–10. Their rejections are sustained for reasons previously expressed with respect to claims that were argued. 37 C.F.R. § 41.37(c)(1)(iv).

CONCLUSION

Claims Rejected	§	Reference(s)/Basis	Affirmed	Rev'd
13, 16, 19, 22	112	Written Description	13, 16, 19, 22	
13, 16, 22	112	Enablement	13, 16, 22	
1-4, 9-11, 18	103	Sharma, Pearson	1-4, 9-11, 18	
5, 8, 12-17, 21	103	Sharma, Pearson, Vettters, Norris, Seda, Waters	5, 8, 12-17, 21	
6, 7	103	Sharma, Pearson, Vettters, Norris, Somanath, Seda, Waters	6, 7	
22	103	Sharma, Pearson, Vettters, Norris, Seda, Waters, Schilling	22	
19, 20	103	Sharma, Pearson, Klees, Warwick	19, 20	
23	103	Sharma, Pearson, Klees, Warwick, Vettters, Norris, Seda, Waters	23	
Overall Outcome			1–23	

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