Paper No. _____
Filed: September 11, 2017

UNITED STATES PATENT AND TRADEMARK OFFICE

_____

BEFORE THE PATENT TRIAL AND APPEAL BOARD

_____

GENERAL ELECTRIC COMPANY,
Petitioner,

v.

UNITED TECHNOLOGIES CORPORATION,
Patent Owner.

_____

Case IPR2016-00524
Patent No. 8,753,065

_____

PATENT OWNER'S NOTICE OF APPEAL

Pursuant to 35 U.S.C. §§ 141(c) and 319 and 37 C.F.R. § 90.2(a), Patent Owner United Technologies Corporation ("UTC") hereby provides notice that it appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered July 10, 2017, (Paper No. 35), and from all underlying orders, decisions, rulings, and opinions relating to U.S. Patent 8,753,065 ("the '065 patent"), set forth in *Inter Partes* Review IPR2016-00524.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), the issues on appeal include, but are not limited to:

- the U.S. Patent and Trademark Office Patent Trial and Appeal Board ("Board") determination that claims 2, 3, 10, and 11 of the '065 patent are unpatentable under 35 U.S.C. § 102 over Hess,[1] including issues relating to the Board's construction of "fan blade tip speed of the fan is less than 1400 fps," and whether the Board's anticipation finding is supported by substantial evidence;

[1] Christopher Hess, *Pratt & Whitney Develops Geared Turbofan*, FLUG REVUE 54-56, 58 (Oct. 1998).

- the Board's determination that claims 10 and 11 of the '065 patent are unpatentable under 35 U.S.C. § 103 over Willis[2] in view of Kurzke,[3] including issues related to the Board's motivation to combine analysis and whether the Board erred in concluding claims 10 and 11 would have been obvious; and
- any other issue decided adversely to UTC in an order, decision, ruling or opinion underlying or supporting the Final Written Decision.

Pursuant to 35 U.S.C. § 142 and 37 C.F.R. § 90.2(a), this Notice is being filed with the Director of the United States Patent and Trademark Office, and a copy of this Notice is being concurrently filed with the Board. In addition, a copy of this Notice and the required docketing fees are being filed with the Clerk's Office for the United States Court of Appeals for the Federal Circuit via CM/ECF.

[2] William S. Willis, *Quiet Clean Short-Haul Experimental Engine (QCSEE) Final Report* (1979).

[3] Joachim Kurzke, *Fundamental Difference between Conventional and Geared Turbofans*, 1 PROCEEDINGS OF ASME TURBO EXPO 2009 145, 145-153 (June 8-12, 2009).

Respectfully submitted,

Date: September 11, 2017

By: /*M. Andrew Holtman*/
M. Andrew Holtman
Reg. No. 53,032

Lead Counsel for Patent Owner

CERTIFICATE OF SERVICE AND FILING

I hereby certify that on this 11th day of September, 2017, in addition to being filed and served electronically through the Board's E2E System, a true and correct copy of the foregoing Patent Owner's Notice of Appeal was served on the Director of the United States Patent and Trademark Office, via Express overnight delivery at the following address:

Office of the General Counsel
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

I also hereby certify that on this 11th day of September, 2017, a true and correct copy of the foregoing Patent Owner's Notice of Appeal and the filing fee, were filed with the Clerk's Office of the United States Court of Appeals for the Federal Circuit, via CM/ECF.

I also hereby certify that on this 11th day of September, 2017, a true and correct copy of the foregoing Patent Owner's Notice of Appeal was served, by electronic mail, upon the following:

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Dated: September 11, 2017

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EXHIBIT A

Trials@uspto.gov
571-272-7822

Paper No. 35
Entered: July 10, 2017

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GENERAL ELECTRIC COMPANY,
Petitioner,

v.

UNITED TECHNOLOGIES CORPORATION,
Patent Owner.

Case IPR2016-00524
Patent 8,753,065 B2

Before HYUN J. JUNG, SCOTT A. DANIELS, and
GEORGE R. HOSKINS, *Administrative Patent Judges.*

JUNG, *Administrative Patent Judge.*

DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

General Electric Company ("Petitioner") filed a Petition (Paper 1, "Pet."), requesting institution of an *inter partes* review of claims 1–11 of U.S. Patent No. 8,753,065 B2 (Ex. 1001, "the '065 patent"). United Technologies Corporation ("Patent Owner") timely filed a Preliminary Response (Paper 6, "Prelim. Resp."). Upon considering these submissions, we instituted *inter partes* review of claims 1–11 of the '065 patent. Paper 7 ("Dec. on Inst.").

After institution, Patent Owner filed a Disclaimer in Patent Under 37 C.F.R. § 1.321(a) that disclaimed claims 1 and 4–9 (Ex. 2018) and filed a Response (Paper 16, "PO Resp."). Petitioner filed a Reply. Paper 25 ("Pet. Reply"). Petitioner proffered the Declarations of Reza Abhari, Ph.D. (Ex. 1003, "Abhari Declaration" or "Abhari Decl.") and of Raymond Drago (Ex. 1005, "Drago Declaration" or "Drago Decl.") with its Petition and a Reply Declaration of Mr. Drago (Ex. 1039) with its Reply. Patent Owner proffered a Declaration of Jack D. Mattingly, Ph.D. (Ex. 2016, "Mattingly Declaration" or "Mattingly Decl."). Also, deposition transcripts were filed for Mr. Drago (Ex. 2010), Dr. Abhari (Exs. 2011, 2014, 2015) and Dr. Mattingly (Exs. 1030, 1038).

An oral hearing in this proceeding was held on May 4, 2017; a transcript of the hearing is included in the record (Paper 34, "Tr.").

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 2, 3, 10, and 11 of the '065 patent are unpatentable.

A. Grounds of Unpatentability at Issue

We instituted *inter partes* review on the grounds that (1) claims 1–11, under 35 U.S.C. § 102, are anticipated by Hess,[1] (2) claim 5, under 35 U.S.C. § 103, is unpatentable over Hess and McCune,[2] (3) claims 1 and 4–9, under 35 U.S.C. § 102, are anticipated by Willis,[3] and (4) claims 10 and 11, under 35 U.S.C. § 103, are unpatentable over Willis and Kurzke.[4] Dec. on Inst. 29–30.

Because Patent Owner filed a Disclaimer in Patent Under 37 C.F.R. § 1.321(a) that disclaims claims 1 and 4–9 (Ex. 2018), we agree with Patent Owner that "only claims 2, 3, 10, and 11 remain at issue in this proceeding." PO Resp. 3.

B. Related Proceedings

The parties indicate that there are no related proceedings involving the '065 patent. Pet. 1; Paper 5, 1.

C. The '065 Patent (Ex. 1001)

The '065 patent relates to "a method for setting a gear ratio of a fan drive gear system of a gas turbine engine." Ex. 1001, 1:8–10. Figure 1 of the '065 patent is reproduced below.

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[1] Christopher Hess, *Pratt & Whitney Develops Geared Turbofan*, FLUG REVUE 54–56, 58 (Oct. 1998) (Ex. 1007, "Hess").
[2] U.S. Patent Application Pub. No. 2010/0331139 A1 to McCune, published Dec. 30, 2010 (Ex. 1010, "McCune").
[3] William S. Willis, *Quiet Clean Short-Haul Experimental Engine (QCSEE) Final Report* (1979) (Ex. 1011, "Willis").
[4] Joachim Kurzke, *Fundamental Differences between Conventional and Geared Turbofans*, 1 PROCEEDINGS OF ASME TURBO EXPO 2009 145, 145–153 (June 8–12, 2009) (Ex. 1009, "Kurzke").

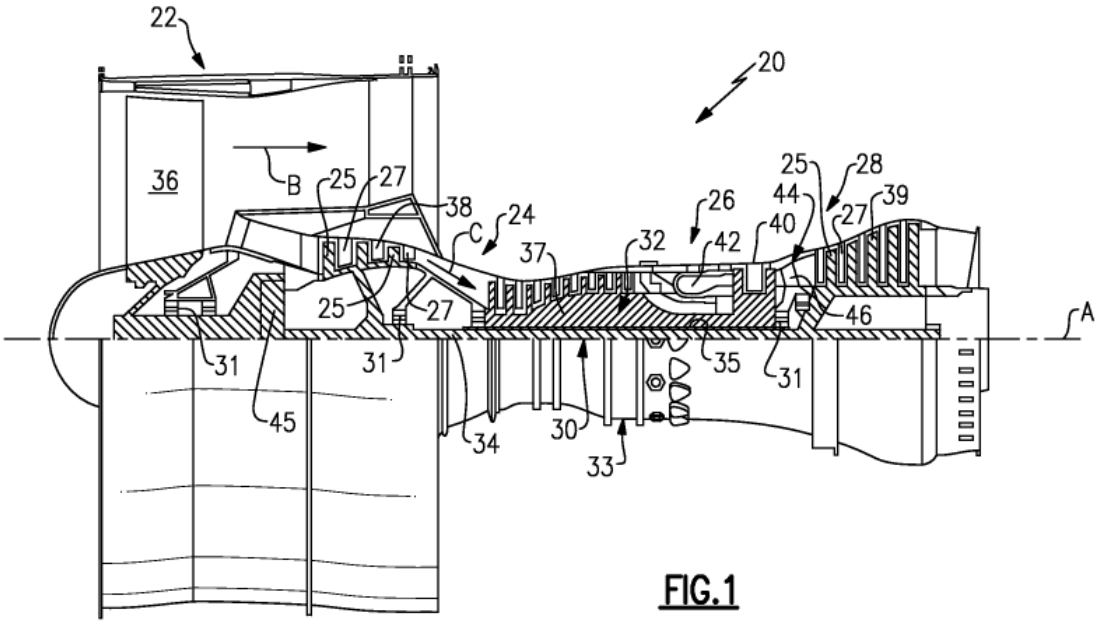


FIG.1

Figure 1 is a schematic, cross-sectional view of a gas turbine engine. *Id.* at 2:66–67, 3:9. Gas turbine engine 20 includes fan section 22, compressor section 24, combustor section 26, turbine section 28, low speed spool 30, and high speed spool 32. *Id.* at 3:10–13, 3:26–28. Low speed spool 30 includes inner shaft 34 that interconnects fan 36, low pressure compressor 38, and low pressure turbine 39. *Id.* at 3:35–37. Inner shaft 34 can be connected to fan 36 through a speed change mechanism, such as geared architecture 45, which drives fan 36 at a lower speed than low speed spool 30. *Id.* at 3:37–42.

Geared architecture 45 can include a star gear system and "enables operation of the low speed spool 30 at higher speeds, which can enable an increase in the operational efficiency of the low pressure compressor 38 and low pressure turbine 39." *Id.* at 4:9–14. Also, inner shaft 34 can be connected to fan 36 through fan drive gear system 50. *Id.* at 5:6–7, Fig. 2.

The ’065 patent also describes for one embodiment that “the bypass ratio [of gas turbine engine 20] is greater than 11 and less than 22, or greater than 13 and less than 20.” *Id.* at 4:24–26. The ’065 patent describes for other embodiments a fan blade tip speed of the fan is less than 1400 feet per second (fps). *Id.* at 1:54–55, 2:47–49. The ’065 patent further describes that “Low Corrected Fan Tip Speed is the actual fan tip speed divided by an industry standard temperature correction” and that, in one embodiment, the “Low Corrected Fan Tip Speed . . . is less than about 1400 fps (427 m/s).” *Id.* at 4:56–58, 4:62–65. Furthermore, the ’065 patent describes improving performance of gas turbine engine 20 “by determining fan tip speed boundary conditions for at least one fan blade of the fan 36 to define the speed of the tip of the fan blade.” *Id.* at 5:50–53.

D. Illustrative Claims

The ’065 patent has 19 claims, of which Petitioner challenges claims 1–11 and Patent Owner disclaims claims 1 and 4–9. Of the challenged claims, claim 1 was the only independent claim. Claims 1 and 2 are reproduced below:

> 1. A gas turbine engine comprising:
> a fan section including a fan rotatable about an axis;
> a speed reduction device in communication with the fan, wherein the speed reduction device includes a star drive gear system with a star gear ratio of at least 1.5,
> wherein a fan blade tip speed of the fan is less than 1400 fps; and a bypass ratio is between about 11.0 and about 22.0.
>
> 2. The gas turbine engine of claim 1, wherein the speed reduction device includes a star gear system gear ratio of at least 2.6.

II. CLAIM CONSTRUCTION

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). Only those terms in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

In the Decision on Institution, we interpreted the following terms of the '065 patent.

Term	**Interpretation**
"gear ratio"	"the ratio of the rotational speed of the input to the gear system to the rotational speed of the output of the gear system"
"bypass ratio"	"the ratio of the mass flow rate of air bypassing the engine core to the mass flow rate of air passing through the engine core"

Dec. on Inst. 7–11. We were also not persuaded that "a fan blade tip speed of the fan is less than 1400 fps," as recited by claim 1, is a speed limit. *Id.* at 8–10.

Neither party presents post-institution arguments or evidence regarding the interpretations of "gear ratio" and "bypass ratio." *See* PO Resp. 8–22; Pet. Reply 3–10. Based on our review of the complete record,

we do not perceive any reason or evidence that now compels any deviation from these interpretations.

Patent Owner presents further arguments and evidence regarding "a fan blade tip speed of the fan is less than 1400 fps." PO Resp. 8–22.

A. "a fan blade tip speed of the fan is less than 1400 fps" (claim 1)

Petitioner proposes a plain meaning that "simply requires a gas turbine engine that is capable of operating with a fan blade tip speed that is less than 1400 fps." Pet. 21–22. Petitioner contends that the challenged claims "do not specify a particular operating condition," that "a person of ordinary skill would understand that the claims do not limit the engine operating parameter ranges (*e.g.*, bypass ratio and fan blade tip speed) to a particular operating condition of the engine," and that the specification does not support "a claim that is limited to a gas turbine engine in which the fan blade tip speed of the engine must *always* be below 1400 fps (or between 1000 and 1400 fps) at *all* operating conditions." Pet. 20, 21 (citing Ex. 1001, 4:39–42, 4:56–67; Abhari Decl. ¶ 48).

Patent Owner proposes interpreting "a fan blade tip speed of the fan is less than 1400 fps" as the "fan blade tip speed of the fan must be less than 1400 fps at all times during operation." PO Resp. 8, 22. Patent Owner contends that the specification explains that improved engine performance begins with determining iteratively fan tip speed boundary conditions that meet a desired number of operating life cycles and results in the claimed engine architecture with the required bypass ratio range, gear reduction ratio range, and fan blade tip speed range that must be less than 1400 fps. *Id.* at 8–9 (citing Ex. 1001, 1:40–45, 2:26–35, 2:50–53, 2:55–58, 5:50–53, 5:63–6:1, 6:62–7:23; Mattingly Decl. ¶¶ 26–28, 41, 43). Patent Owner also

argues that the "intrinsic record establishes the criticality" of the claimed fan blade tip speed "as an ever-present upper boundary." *Id.* at 15–16 (citing Mattingly Decl. ¶¶ 26–54).

According to Patent Owner, one of ordinary skill would have understood the '065 patent as disclosing that fan blade tip speed is based on (1) boundary conditions that must not be exceeded, (2) stress levels that are lowered by lowering the gear reduction ratio, and (3) the number of operating life cycles that is desired. *Id.* at 9–12 (citing Ex. 1001, 5:63–6:3; Mattingly Decl. ¶¶ 26–28, 30, 34–44, 52). Patent Owner, thus, argues that one of ordinary skill in the art would have concluded that the '065 patent defines a maximum fan blade tip speed that applies throughout engine operation and not a mere capability that can be met at some point in operation. *Id.* at 10, 12 (citing Mattingly Decl. ¶¶ 43–47, 52).

In response to Petitioner's proposal that "the plain meaning of claim 1 simply requires a gas turbine engine that is capable of operating with a fan blade tip speed that is less than 1400 fps," Patent Owner contends that it "ignores the specification," "is contrary to how a person of ordinary skill would have understood the term," and "ignores the purpose of the '065 patent's invention." *Id.* at 8. Patent Owner also argues that the Abhari Declaration inadequately considers the specification (*id.* at 13, 15 (citing Ex. 1003, 29–30)) and that Petitioner cites a portion of the specification that relates to fuel efficiency, not the selection of boundary conditions for fan blade tip speed (*id.* at 14–15 (citing Pet. 21–22; Ex. 1001, 4:39–44; Mattingly Decl. ¶¶ 48–49)).

Patent Owner additionally argues that Petitioner's interpretation is "out of keeping" with the specification of the '065 patent because

Petitioner's interpretation "would frustrate the purpose of the '065 patent" (PO Resp. 16 (citing Mattingly Decl. ¶¶ 29, 46, 52–54)), would "disregard the specification's emphasis on managing fan stress levels and durability requirements" (*id.* (citing Ex. 1001 at 2:29–31, 5:50–53, 6:62–7:3)), and "is wholly unsupported by, and . . . contradicts, the specification" (*id.* at 17). Patent Owner contends that the '065 patent is directed to "a process that 'begins' by 'defin[ing] the speed of the tip of the fan blade'" (*id.* at 18 (citing Ex. 1001 at 5:51–53, 5:63–66)) so as to result in an upper limit based on the fan blade tip speed that, in turn, determines the "entire engine architecture . . . to ensure the structural integrity of the fan for the duration of its intended operational life" (*id.* (citing Mattingly Decl. ¶¶ 26–28, 41, 43)). Patent Owner, thus, asserts that Petitioner's interpretation "could be met by any fan blade that even momentarily operates under 1400 fps" that "would *not* achieve the '065 patent's performance and longevity goals." *Id.* at 18 (citing Mattingly Decl. ¶¶ 45, 46, 52–54).

Patent Owner further argues that Petitioner's interpretation renders the limitation meaningless because most, if not all, gas turbine engines would meet Petitioner's interpretation of the limitation. PO Resp. 8, 19–21 (citing Ex. 2015 at 23:7–16, 28:5–29:9; Mattingly Decl. ¶¶ 44, 54). Patent Owner, thus, asserts that "[i]n light of the purpose explained in the specification, it is apparent that . . . the '065 patent 'intended to envelop' . . . a requirement that fan blade tip speed is less than 1400 fps throughout the engine's operation." *Id.* at 21 (citing Mattingly Decl. ¶¶ 46, 47, 52–54).

Petitioner replies that Patent Owner's proposed interpretation amounts to an attempt to circumvent our rules for amending claims and does not meet the burden of showing patentability of amended claims over the prior art of

record. Pet. Reply 3–4 (citing PO Resp. 52; Ex. 1030, 38:3–6; Ex. 1031, 1–2, 10–11, 42–43, 60–61; Ex. 1034, 7; Ex. 1035, 8). Petitioner also contends that the specification of the '065 patent does not support Patent Owner's position because it does not describe the fan tip blade speed as a maximum and instead describes designing the engine for a particular flight condition. *Id.* at 4–5 (citing Ex. 1001, 1:54–55, 2:25–26, 2:46–47, 4:39–42, 4:56–67, 5:50–53; Ex. 1025, 2). Petitioner further contends that Patent Owner's proposed interpretation is not the broadest reasonable interpretation because the specification does not define fan blade tip speed as a maximum and conflicts with what one inventor of the '065 patent said in an application with similar discussion about fan blade tip speed. *Id.* at 5–8 (citing PO Resp. 21; Ex. 1032, 8, 15, 22, 35, 58). Petitioner further asserts that the specification of the '065 patent conflicts with Patent Owner's declarant testimony regarding claim construction. *Id.* at 8–10 (citing Ex. 1001, 4:62–65; Ex. 1030, 37:3–22; Mattingly Decl. ¶ 47). Petitioner additionally argues that there is no basis for reading a limitation from a method claim of the '065 patent into the challenged apparatus claims. *Id.* at 10.

Having the benefit of a fully developed record before us, we review anew the evidence regarding "a fan blade tip speed of the fan is less than 1400 fps." For the reasons set forth below, we interpret claim 1 to require a gas turbine engine with a fan blade tip speed less than 1400 fps in combination with the other recited limitations, such as those regarding gear ratio and bypass ratio.

Turning first to the claims, claim 1 requires a "gas turbine engine" with "a fan section including a fan rotatable about an axis . . . wherein a fan blade tip speed of the fan is less than 1400 fps." Ex. 1001, 6:25–32. Claim

11, which depends indirectly from claim 1, recites "wherein the fan blade tip speed of the fan is greater than 1000 fps." *Id.* at 6:58–59. Claim 1 does not require explicitly that the "fan blade tip speed of the fan must be less than 1400 fps *at all times during operation*," as proposed by Patent Owner. Also, none of the claims depending from claim 1 explicitly requires or indicates fan blade tip speed to be less 1400 fps at all times.

Turning next to the specification, Petitioner points to column 4, lines 39–42 and 56–67, to argue that 1400 fps is not a maximum speed and is not measured at take-off. Pet. 21. Patent Owner points to several portions of the specification that relate to improving engine performance (Ex. 1001, 1:40–45), determining fan tip speed boundary conditions for at least one fan blade (*id.* at 2:26–35, 5:50–53), and lowering stress levels in the fan blade to meet desired number of operating life cycles (*id.* at 2:50–53, 2:55–58, 5:63–6:1). *See* PO Resp. 8–9, 16 (citing Ex. 1001, 1:40–45, 2:26–35, 2:50–53, 2:55–58, 5:50–53, 5:63–6:1).

We find that the specification of the '065 patent describes a method of improving performance of a gas turbine that includes determining fan tip speed boundary conditions for at least one fan blade. Ex. 1001, 2:27–30, 5:50–6:3. We also find that the specification describes that, in some embodiments, the fan blade tip speed can be less than 1400 fps. *Id.* at 1:54–55, 2:47–49. The specification also describes that the "Low Corrected Fan Tip Speed" of gas turbine 20 is less than 1400 fps or 427 m/s. *Id.* at 4:62–65. We additionally find that the specification describes that stress level constraints in the at least one fan blade determine if the rotary speed in the fan section meets a desired number of operating cycles. *Id.* at 2:31–35, 5:63–66. If a stress level in the fan blade is too high to meet a desired

number of operating cycles, then the gear ratio, number of stages in the low pressure turbine, and annular area of the low pressure turbine can be adjusted. *Id.* at 2:30–35, 5:57–6:3; *see also* Mattingly Decl. ¶ 24 (stating "[m]ethods for selecting conditions that provide an optimum gear ratio for a fan drive gear system are also disclosed"), ¶ 27 (stating "[i]f stress levels exceed a maximum that the designer has in mind, parameter values then must be changed, in iterative fashion, to accommodate the design objectives and maximums").

We do not find, however, that the specification describes expressly that fan blade tip speed must be less than 1400 fps *at all times during operation*, that 1400 fps is a maximum speed, or that 1400 fps is included in fan tip speed boundary conditions. We find no clear link between "determining fan tip speed boundary conditions for at least one fan blade of the fan 36 to define the speed of the tip of the fan blade" (Ex. 1001, 5:50–6:3) and the earlier descriptions of the "Low Corrected Fan Tip Speed" being less than about 1400 fps for an embodiment of gas turbine 20 (*id.* at 4:56–65) or embodiments with fan blade tip speed less than 1400 fps (*id.* at 1:54–55, 2:47–49).

Moreover, even if a fan blade tip speed of less than 1400 fps is included in the fan tip speed boundary conditions, the '065 patent does not describe how such boundary conditions are related to limits that must be observed at all times during operation including non-steady state conditions. *See* Ex. 1030, 37:18–22 (When asked "is it your opinion that the range of a thousand to 1400 feet per second in Claims 1 and 11 is a range for an actual engine or is it a range for the design process," Dr. Mattingly answered "[i]t's a range for the design process."), 37:23–38:2 (When asked whether the

"term fan tip speed in these claims means maximum fan tip speed," Dr. Mattingly answered "we're talking about the fan tip speed steady state maximum value that corresponds to longevity of the engine."); Mattingly Decl. ¶ 24 (Dr. Mattingly states that the "patent describes . . . operating parameters (fan pressure ratio, blade tip speed and bypass ratio) that, in combination, define a design 'sweet-spot.'"); *see also* Abhari Decl. ¶ 35 (Dr. Abhari states "fan's tip speed cannot go much above 450 m/s – above that point, noise starts to become unacceptable") (quoting Ex. 1012, 1).

Turning next to the prosecution history, neither party relies on the prosecution history of the '065 patent. *See* Pet. 20–21 (arguments regarding related European application) (citing 1025, 2); Pet. Reply 4 (arguments regarding related abandoned application) (citing Ex. 1030, 10–11; Ex. 1031, 1, 32, 42, 43, 60 61).

For the reasons above, we do not adopt Patent Owner's proposed interpretation for "a fan blade tip speed of the fan is less than 1400 fps." For purposes of this Decision we interpret the remaining challenged dependent claims, which depend from claim 1, to require a gas turbine engine with a fan blade tip speed less than 1400 fps in combination with the other recited limitations, such as those regarding gear ratio and bypass ratio.

B. Other terms

We determine that an express interpretation of any other term is not necessary for the purposes of this Decision.

III. CHALLENGE BASED ON HESS

As discussed above, Petitioner challenges claims 1–11 as anticipated by Hess. Patent Owner, however, filed a disclaimer for claims 1 and 4–9.

We, thus, analyze the challenge to the claims remaining at issue in this proceeding.

To prevail in the challenge of claims 2, 3, 10, and 11 as anticipated by Hess, Petitioner must prove unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). In finding a claim anticipated, "[t]he identical invention must be shown in as complete detail as is contained in the patent claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989), *abrogated on other grounds as recognized by Robert Bosch LLC v. Pylon Mfg. Corp.*, 659 F.3d 1142, 1148 (Fed. Cir. 2011). Moreover, "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987).

Petitioner contends that claims 2, 3, 10, and 11 are anticipated by Hess with citations to Hess (Ex. 1008), the Abhari Declaration (Ex. 1003), and the Drago Declaration (Ex. 1005). Pet. 22–35.

A. Hess[5] *(Ex. 1008)*[6]

Hess is titled "[t]he first geared fan PW8000." Ex. 1008, 3. Hess states that "[c]onventional turbofans comprise a high-pressure and a low-pressure shaft, each of which respectively showing a compressor and a turbine section" and "[d]ue to the fact that the supercharger, the fan, is usually directly coupled to the low-pressure shaft system both of them run at the same speed." *Id.* at 4. Hess also states that "[b]y the interposition of a step-down gear unit it is possible to decouple the fan from the low-pressure turbine." *Id.* Hess indicates that "[t]his principle is not new" and that "[i]n the early nineties . . . MTU developed, together with its partner Fiat, such a step-down gear unit for turbofans." *Id.*

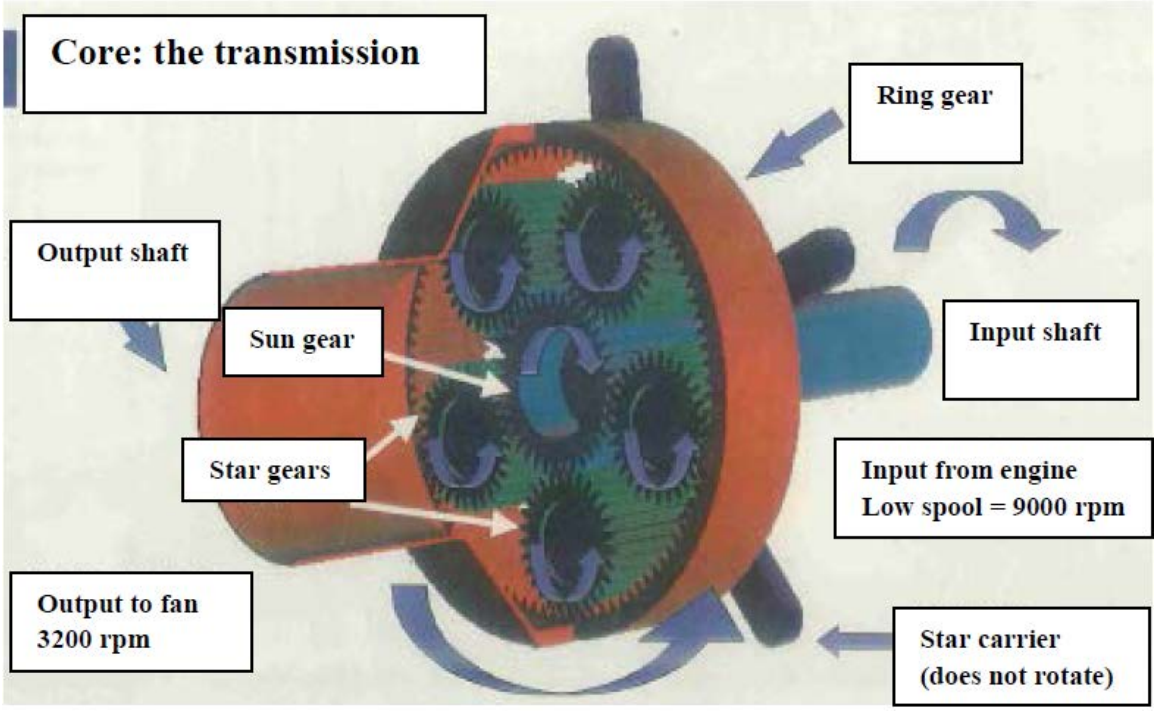
Hess discloses that the PW8000 is "driven not directly by the low pressure shaft system but via a step-down gear unit." *Id.* The PW8000 is "subject to a gear reduction at a ratio 3:1" so that "the fan then spins at one third the speed of the remaining low-pressure system." *Id.* Hess also states

[5] The Decision on Institution determines that arguments in Patent Owner's Preliminary Response challenging the public accessibility of Hess are not persuasive because Hess itself includes indications that a large number of copies were printed and distributed. *See* Dec. on Inst. 12–13. Patent Owner's counsel also stated at the hearing that Patent Owner no longer challenges the public accessibility of Hess. *See* Tr. 31:4–13 (When asked about Patent Owner's objection to Hess as being publicly available, Patent Owner's counsel stated it no longer maintained the objection.); *In re Nuvasive, Inc.*, 842 F.3d 1376, 1380–1381 (Fed. Cir. 2016).

[6] Citations to Hess in this Decision are to the corrected translation, the exhibit titled "Corrected GE-1008" filed on August 5, 2016, also numbered 1008 and the exhibit page numbers in the lower right corner of that exhibit. We determined that the certificate of translation of Hess was deficient. *See* Dec. on Inst. 14–15. Petitioner filed a corrected certificate of translation as part of the exhibit titled "Corrected GE-1008."

that "a bypass ratio of approximately 11:1 can be realized with a [fan] diameter of 1.93 m." *Id.* at 5.

Under the heading "Technical data* PW8000," Hess lists "Fan diameter" as being "1.83 – 1.93 m," "Bypass ratio" as being "approx. 10:1," and "Step-down ratio" as being "3:1." *Id.* at 4. The "*" indicating "preliminary information." *Id.* Hess includes a figure of a "Core: the transmission" that is reproduced below.



The figure is a sectional view of a transmission. The figure shows a "Sun gear," "Star gears," and "Ring gear." *Id.* at 5. The figure also shows "Output to fan 3200 rpm" and "Input from engine Low spool = 9000 rpm." *Id.*

B. Claims 2, 3, 10, and 11

Petitioner contends that Hess discloses every limitation of independent claim 1, from which claims 2, 3, 10, and 11 directly or indirectly depend. Pet. 24–28 (citing Abhari Decl. ¶¶ 51–56; Drago Decl.

¶¶ 44–45; Ex. 1008, 4–5). Other than "a fan blade tip speed of the fan is less than 1400 fps," the parties do not dispute that Hess discloses the other limitations of claim 1 or claims 2, 3, 10, and 11 that depend from claim 1. *See* PO Resp. 25 ("In summary: (a) Hess does not expressly disclose a fan blade tip speed, and (b) . . . that number is not an upper boundary of speed limit.").

Based on the full record before us, we adopt Petitioner's contentions as our findings for the uncontested limitations of claims 1–3, 10, and 11 because the cited portions of Hess support Petitioner's assertions. *See* Pet. 24–26 (arguing Hess discloses the limitations of claim 1) (citing Abhari Decl. ¶¶ 51–53; Drago Decl. ¶¶ 44–45; Ex. 1008, 3–5), 28–29 (arguing Hess discloses a gear ratio of 2.8, thereby anticipating a gear ratio of at least 2.6 and less than or equal to 4.1, as required by claims 2 and 3) (citing Abhari Decl. ¶ 57; Drago Decl. ¶ 46), 34–35 (arguing Hess discloses a low pressure turbine that is mechanically attached to a sun gear and that has three stages, as required by claim 10 and Hess discloses a fan diameter of 1.93 meters, a fan rotational speed of 3,200 RPM, and thus a fan blade tip speed of 1060 fps, as required by claim 11) (citing Abhari Decl. ¶¶ 54, 55, 61, 62; Drago Decl. ¶¶ 54–56; Ex. 1008, 5).

Specifically, for the recitation "wherein a fan blade tip speed of the fan is less than 1400 fps," Petitioner cites Hess for disclosing a fan diameter of 1.93 meters and a fan rotational speed of 3,200 RPM. *Id.* at 27 (citing Ex. 1008, 5). Using the diameter and rotational speed, Petitioner calculates that the fan blade tip speed is 1060 fps and argues that Hess, thus, discloses "a fan blade tip speed of the fan is less than 1400 fps." *Id.* at 27–28 (citing Abhari Decl. ¶¶ 54–55); *see also* Ex. 1030 30:10–14 (Dr. Mattingly

testifying that "fan tip speed is calculated straightforward from the rotational speed of the fan and the fan diameter of the tip so you'd have to have measurements of both to determine the fan tip speed").

Patent Owner responds that Petitioner improperly picks and chooses from different designs described in Hess. PO Resp. 22, 27. Patent Owner also responds that no matter how Hess's various designs are combined, Petitioner cannot demonstrate a teaching or suggestion of a fan blade tip speed that is less than 1400 fps at all times during operation. *Id.* at 23.

Specifically, Patent Owner argues that Hess discloses "*several* engine or transmission designs" but does not disclose a fan blade tip speed for any design or a fan diameter for calculating fan blade tip speed. *Id.* at 23–27 (citing Ex. 1008, 4, 5; Mattingly Decl. ¶¶ 60–67, 70–71). Patent Owner contends that Hess discloses four designs: (1) a PW8000 geared turbofan engine, (2) an alternative PW8000 design with a bypass ratio of approximately 11:1 and fan diameter of 1.93 m, (3) a PW2037 ADP engine that provided the basis for PW8000 gearbox, and (4) a "Core: the transmission" graphic that yields a reduction ratio of 2.8:1 instead of 3:1 described for the PW8000. *Id.* at 24–27 (citing Ex. 1008, 4, 5; Mattingly Decl. ¶¶ 64–65, 67, 70–71).

Patent Owner also contends that Petitioner assumes Hess discloses a "single, integrated design" and improperly combines the bypass ratio and the fan blade diameter of the alternative PW8000 with the gear ratio and output shaft speed of the transmission graphic without establishing that the transmission graphic represents the alternative PW8000 design. *Id.* at 27–29. Patent Owner argues that the transmission graphic "contains no legend or other text linking it to the Alternative PW8000 design, nor does the

balance of Hess provide such a linkage" and that the single sentence about the alternative PW8000 design does not refer to the transmission graphic. *Id.* (citing Ex. 1008, 4, 5; Mattingly Decl. ¶¶ 64–65, 71).

Patent Owner asserts that the "Core: the transmission" graphic appears to relate to the PW2037 ADP engine because Hess indicates that the "PW2037 ADP transmission represents a 'core' function in the development of the PW8000." *Id.* at 30 (citing Ex. 1008, 4, 5; Mattingly Decl. ¶¶ 63, 71). Patent Owner also argues that Hess provides some indication that the transmission graphic does not relate to the alternative PW8000 design because Hess's description of the alternative PW8000 design is after discussing a 3:1 gear ratio, thus suggesting the alternative PW8000 design has a 3:1 gear ratio, instead of the 2.8:1 gear ratio that can be calculated from the transmission graphic. *Id.* at 30–31 (citing Ex. 1008, 5; Mattingly Decl. ¶ 66). Patent Owner further asserts that Hess does not disclose a gear ratio for the alternative PW8000 engine and one of ordinary skill in the art would not understand that the 2.8:1 gear ratio is for the alternative PW8000 engine. *Id.* at 32–34 (citing Mattingly Decl. ¶¶ 67–71). Patent Owner further argues that the 3:1 ratio described in the text is not an approximation of the 2.8:1 ratio depicted in the graphic. *Id.* at 31–32 (citing Mattingly Decl. ¶¶ 57, 64–66). Petitioner replies to Patent Owner's arguments. Pet. Reply 10–18.

The parties do not dispute that Hess describes, at least, the PW8000. Pet. 22 ("Hess describes a high bypass ratio geared turbofan engine called the PW8000."); PO Resp. 23–26 (arguing Hess discloses the PW8000, an alternate PW8000 design, and PW2037 ADP). Hess states that the "development of turbofan engines has reached a turning" because "for the

first time a supercharger of a turbofan engine produced on an industrial scale shall be driven not directly by the low pressure shaft system but via a step-down gear unit." Ex. 1008, 4.

Hess describes this "step-down gear unit" in detail because the low pressure shaft does not drive the supercharger or fan directly. Hess explains that a transmission for an abandoned advanced ducted propulsor ("ADP") "represent[s] the foundation of the transmission of the novel, step-down turbofan." Ex. 1008, 4. Hess also describes that the PW8000's transmission is a "smaller version" of the ADP transmission. *Id.* Hess further describes that the ADP-transmission was operated for 600 hours, with 500 of those hours at maximum output, and completed 100 hours of operation in the PW2037 engine. *Id.* at 5. Hess provides a cut-away schematic of the PW8000 (*id.* at 3–4) and includes photos captioned as the "step-down transmission of the PW8000" and the "transmission . . . based on a design developed . . . within the scope of the ADP" (*id.* at 4–5). Hess additionally describes the "novel lubrication system implemented in the concept of the ADP/PW8000 transmission." *Id.* at 4.

In view of Hess's description of the PW8000 geared turbofan engine with details regarding the history, design, and features of its transmission, we find that the graphic labeled "Core: the transmission" must be for the PW8000 transmission. The single sentence regarding the testing of the PW8000 transmission in a PW2037 model engine (Ex. 1008, 5) is not enough to link the graphic labeled "Core: the transmission" to only the PW2037 transmission. Also, because Hess states that the "question of fan diameter is irrelevant for the transmission itself" (*id.*), we find that Hess describes using the same transmission for both a PW8000 with a 1.93 meter

diameter fan and a PW8000 with a 1.83 meter diameter fan. Further, Hess describes that the PW8000's transmission is a "smaller version" of the ADP transmission. *Id.* at 4. Thus, because Hess discloses that the PW8000 with 1.93 or 1.83 meter diameter fan and the PW2037 ADP have the same gear but of different sizes, we find that the gear shown in the graphic labeled "Core: the transmission" is for, at least, the PW8000 with a 1.93 meter diameter fan.

Patent Owner also responds that Hess does not disclose a "fan blade tip speed . . . is less than 1400 fps" at all times during operation. PO Resp. 34. Patent Owner contends that Hess does not disclose a fan blade tip speed for any designs discussed therein and even if one could be derived, Hess does not disclose a boundary condition for fan blade tip speed. *Id.* at 34–35. Patent Owner also contends that Petitioner does not show that a skilled artisan would understand any derived fan blade tip speed to be kept below 1400 fps during engine operation. *Id.* As discussed above in Section II.A., we are not persuaded that "a fan blade tip speed of the fan is less than 1400 fps" means a "fan blade tip speed of the fan must be less than 1400 fps at all times during operation," as proposed by Patent Owner.

Also, for the reasons discussed above in connection with Hess and the limitations of claim 1, we are persuaded that Hess discloses that the PW8000 engine has a bypass ratio of 11:1 and a fan blade tip speed less than 1400 fps, along with the other limitations of claim 1, as discussed above in Section II.A. *See also* PO Resp. 28 (chart indicating that the alternate version of PW8000 has a bypass ratio of 11:1 and fan diameter of 1.93 meters). Thus, a preponderance of the evidence demonstrates that Hess

discloses a gas turbine engine "wherein a fan blade tip speed of the fan is less than 1400 fps; and a bypass ratio is between about 11.0 and about 22.0."

Patent Owner does not present any further arguments specifically for the limitations of claims 2, 3, 10, and 11, which depend from claim 1. Accordingly, for the foregoing reasons, we are persuaded that Petitioner demonstrates, by a preponderance of the evidence, that claims 2, 3, 10, and 11 of the '065 patent are anticipated by Hess.

IV. CHALLENGE BASED ON WILLIS AND KURZKE

To prevail in its challenge of claims 10 and 11 as unpatentable over Willis (Ex. 1011) and Kurzke (Ex. 1009), Petitioner must prove unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). To establish obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *See CFMT, Inc. v. Yieldup Int'l Corp.*, 349 F.3d 1333, 1342 (Fed. Cir. 2003); *In re Royka*, 490 F.2d 981, 985 (CCPA. 1974).

A patent claim composed of several elements, however, is not proved obvious merely by demonstrating that each of its elements was known, independently, in the prior art. *KSR*, 550 U.S. at 418. For an obviousness analysis, it is important to identify a reason that would have prompted one of

skill in the art to combine prior art elements in the way the claimed invention does. *Id.* Obviousness can be established when the prior art, itself, would have suggested the claimed subject matter to a person of ordinary skill in the art. *In re Rinehart*, 531 F.2d 1048, 1051 (CCPA 1976).

Petitioner contends that Willis (Ex. 1011) teaches or suggests every limitation of independent claim 1 with citations to Willis, the Abhari Declaration (Ex. 1003), and the Drago Declaration (Ex. 1005). Pet. 39–44. Petitioner also contends that claims 10 and 11, which depend from claim 1, are rendered obvious by Willis and Kurzke (Ex. 1009) with citations to these references and the Abhari Declaration. *Id.* at 52–59.

A. Willis (Ex. 1011)

Willis is titled "Quiet Clean Short-Haul Experimental Engine (QCSEE) Final Report." Ex. 1011, 1. Willis states that the QCSEE program "included the design, fabrication, and testing of turbofan propulsion systems for . . . aircraft" and "resulted in the recommendation for very low fan pressure ratios and correspondingly high bypass ratios." *Id.* at 19, 24. Willis also states that the "low fan-tip speed, used in conjunction with a 2.5-reduction gear ratio, permitted the use of a conventional high-speed, low-pressure turbine." *Id.* at 32. Figure 8 of Willis is reproduced below.

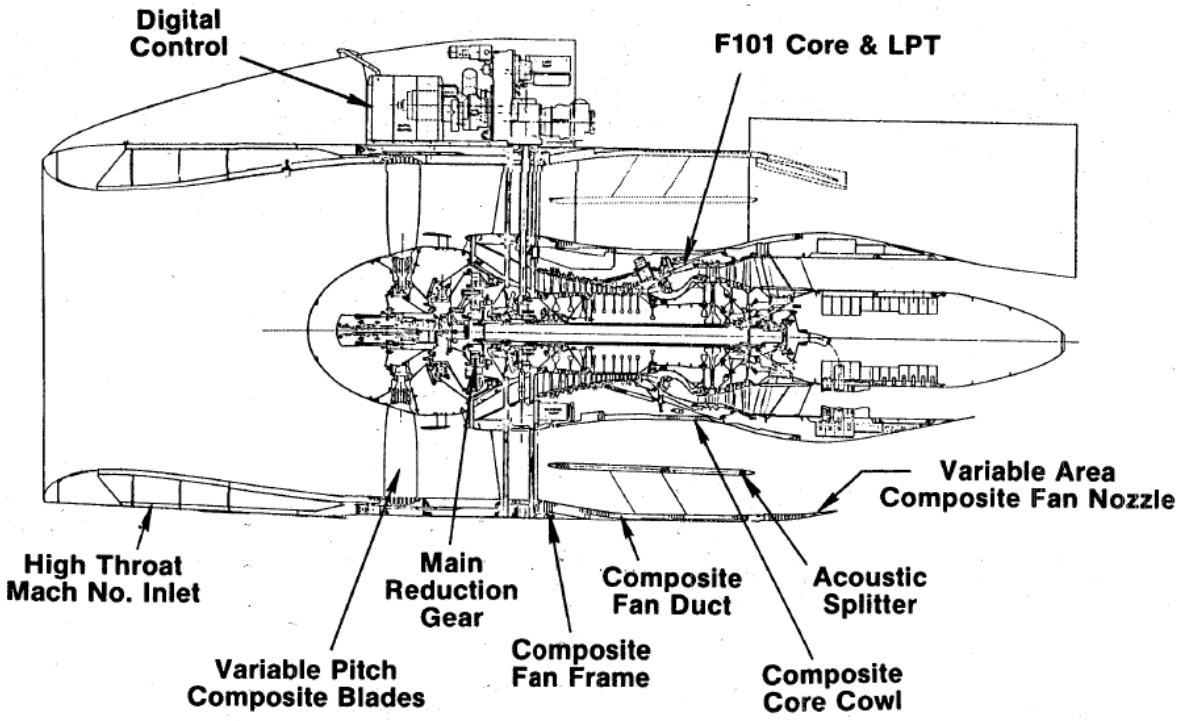


Figure 8. UTW Engine Cross Section.

Figure 8 shows a sectional view of an Under-the-Wing ("UTW") engine. *Id.* at 19, 32, 33. Table III of Willis is reproduced below.

Table III. UTW Design Parameters.

Total Airflow, kg/s (lb/sec)	405.5 (894))
Fan Tip Diameter, cm (in.)	180.3 (71)
Fan Tip Speed, m/s (ft/sec)	289.6 (950)
Bypass Ratio	11.8
Fan Pressure Ratio	1.27
Overall Pressure Ratio	13.7
Jet Velocity (Core), m/s (ft/sec)	244.7 (803)
Jet Velocity (Bypass), m/s	204.2 (670)
Gear Ratio	2.5

Table III of Willis lists the "major design parameters of the UTW engine." *Id.* at 32. Willis states that the "QCSEE concept is based on a lightweight, high-speed, power turbine driving a slower speed, quiet fan" and "required a compatible, compact, lightweight, high-power-capability, main reduction gear." *Id.* at 88. Willis describes an UTW reduction gear with a "[p]ower turbine coupling to input gear" and "[p]ower output gear to fan shaft." *Id.* at 92. Willis also states that "[f]eatures of the YT-49 gear utilized in the QCSEE main reduction gears include the fixed carrier star configuration, flexibility in the sun and ring gears . . . and . . . roller bearings . . . integral with the star gear." *Id.*; *see also id*. at 91 (Fig. 48 showing six star gears, a star carrier, and a ring gear), *id*. at 94 (stating that the "QCSEE fixed-carrier, epicyclic, star-system reduction" includes a "[f]ixed star gear support," "[s]un gear," "[s]tar gears," and "[r]ing gear").

B. Kurzke (Ex. 1009)

Kurzke states that a "gearbox makes the rotational speed of the fan independent from the booster and the LPT." Ex. 1009, 17. Kurzke examines "geared turbofans with two booster and three LPT stages . . . over a range of bypass ratios from 10 to 14." *Id.* Figure 18 of Kurzke is reproduced below.

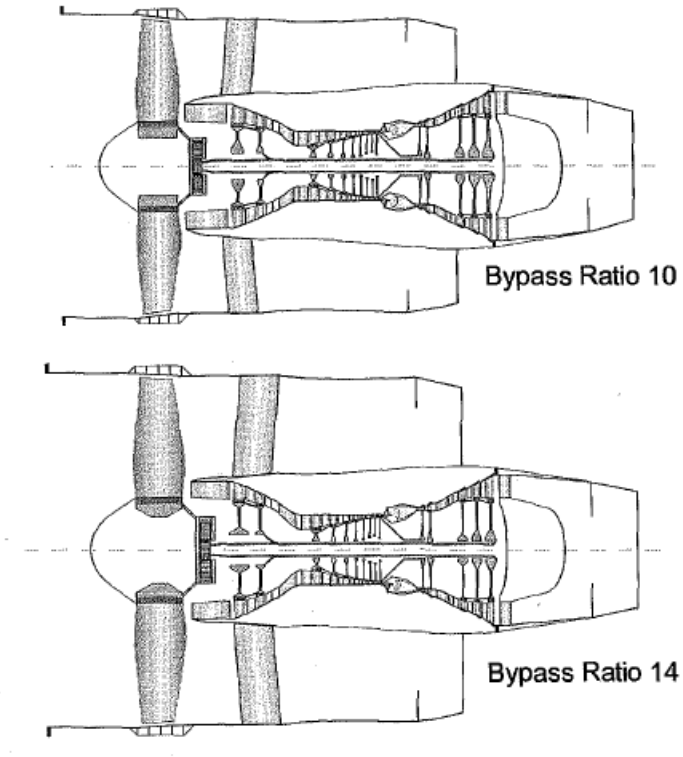


Figure 18: Geared turbofans with bypass ratio 10 and 14

Figure 18 shows "Geared turbofans with bypass ratio 10 and 14." *Id.* at 19.

C. Claim 1

Petitioner contends that Willis discloses every limitation of claim 1, from which claims 10 and 11 depend. Pet. 41–44 (citing Abhari Decl. ¶¶ 66, 68–70; Drago Decl. ¶¶ 70, 71; Ex. 1011, 19, 33, 34, 38, 41, 91, 92, 94, Figs. 8, 48, 50). We have reviewed Petitioner's evidence of anticipation and are persuaded that Willis meets the elements of claim 1 with respect to anticipation. Pet. 41–44. In light of Patent Owner's disclaimer of and lack of dispute as to claim 1, and our review and comparison of Willis to the elements of claim 1, we adopt Petitioner's contentions as our findings for the uncontested limitations of claim 1 because the cited portions of Willis support Petitioner's assertions. Pet. 41–44 (arguing Willis discloses the

limitations of claim 1) (citing Abhari Decl. ¶¶ 66, 68, 69; Drago Decl. ¶¶ 70, 71; Ex. 1011, 19, 38, 41, 91, 92, 94, Fig. 48, Table V).

D. Claim 10

Claim 10 depends from claim 1 and requires the gas turbine engine of claim 1 to include "a low pressure turbine section in communication with the speed reduction device, wherein the low pressure turbine section includes at least three stages and no more than four stages." Ex. 1001, 6:54–57. Petitioner argues that "while Willis discloses a two-stage low pressure turbine," a "three or four stage low pressure turbine . . . would have been obvious to a person of ordinary skill in the art in view of Kurzke 2009." Pet. 53 (citing Abhari Decl. ¶¶ 75–83); *see also id.* at 59 (citing Abhari Decl. ¶¶ 79–83; Ex. 1009, 17; Ex. 1011, 32). Petitioner asserts Kurzke teaches or suggests that turbofan engines include a three-stage low pressure turbine. *Id.* at 55 (citing Abhari Decl. ¶¶ 77–78; Ex. 1009, 17).

Petitioner contends that it would have been obvious to combine Willis and Kurzke to arrive at a three or four stage low pressure turbine because "adding a third stage to the low pressure turbine would have been common practice, and the mere duplication of a part that would have yielded an expected result." Pet. 56 (citing Ex. 1002, 49). Petitioner also contends that Kurzke teaches or suggests that "it would [have been] practical to have a low pressure turbine section having three stages." *Id.* (citing Abhari Decl. ¶ 80). Petitioner further contends that "a person of ordinary skill . . . would understand that a low pressure turbine having three stages would be practical for the engine disclosed by Willis." *Id.* (citing Abhari Decl. ¶ 80).

Based on a statement in Willis that a "more optimum cycle could have been produced by adding booster stages to the fan or by increasing the

pressure ratio," Petitioner argues that Kurzke "expressly teaches that the number of stages in the low pressure turbine can be varied to optimize performance" (Pet. 56–57 (citing Abhari Decl. ¶ 81; Ex. 1011, 26)) and that a "person of ordinary skill would have been motivated by [Willis] to optimize the engine disclosed by Willis, which would have . . . included consideration of additional stages in the low pressure turbine" (*id.* at 57 (citing Abhari Decl. ¶ 81; Ex. 1011, 26)). *See also* Tr. 16:18–17:14 (Petitioner's counsel explaining that booster stages to the fan relate to the low pressure compressor, not the low pressure turbine). Petitioner also contends that "it would have been obvious to vary the number of stages . . . to determine if it would yield an increase in low pressure turbine and engine efficiency." Pet. 57 (citing Abhari Decl. ¶ 81; Ex. 1011, 26). Petitioner cites Figure 4 of Kurzke as disclosing the "effect that the number of stages in the low pressure turbine has on low pressure turbine efficiency for a given gas turbine engine configuration." *Id.* at 56 (citing Abhari Decl. ¶ 81).

Petitioner additionally argues that the "number of stages in the low pressure turbine is also a design choice dictated by a variety of factors" and "it would have been obvious to arrive at a three or four stage low pressure turbine depending on what factors dictated the engine design." *Id.* at 57 (citing Abhari Decl. ¶ 82; Ex. 1011, 26).

Patent Owner responds that a person of ordinary skill would not have been motivated to combine Willis and Kurzke. PO Resp. 35. Patent Owner contends that arguments regarding "common practice," "practicality," and "capability" "may indicate something about what a skilled artisan 'could' have perhaps have done" but "none of them establish that a person of ordinary skill 'would' have made the proposed combination." *Id.* at 36; *see*

also id. at 45–46 (arguing can or could does not lead to concluding one of ordinary skill would have combined references). Patent Owner also responds that "common practice" would have involved "complex analysis and modeling to determine if such a change is appropriate in a particular application" and Petitioner has not shown it would have been appropriate for Willis. *Id.* at 37 (citing Mattingly Decl. ¶¶ 20, 30–39, 52, 87). Patent Owner further argues that the "practicality" argument is impermissible hindsight reasoning. *Id.* at 42–43. Patent Owner's arguments are persuasive, and we agree that "common practice," "practicality," and "capability" are insufficient rationales for combining Willis and Kurzke to arrive at claims 10 and 11.

Regarding the statement in Willis that a "more optimum cycle could have been produced by adding booster stages to the fan or by increasing the pressure ratio," Patent Owner responds that Petitioner (1) fails to provide evidentiary support that adding booster stages would have likely required additional low pressure turbine stages, (2) fails to explain why adding booster stages is more desirable than increasing core pressure ratio, (3) fails to explain why optimizing would not lead to other alterations, and (4) fails to explain the impact of adding low pressure stages on the gearbox or fan. PO Resp. 40–41 (citing Mattingly Decl. ¶¶ 52, 95–96); *see also id.* at 45 (arguing adding booster stages to the fan would likely necessitate adding low pressure turbine stages is speculative). Petitioner replies that Willis indicates that a more optimum cycle could be produced by adding booster stages, as testified to by Dr. Abhari. Pet. Reply 19.

Patent Owner further responds that "Petitioner provides no analysis to suggest that the resulting low pressure turbine would include three stages."

PO Resp. 41 (citing Mattingly Decl. ¶ 96). Patent Owner asserts that Willis has a two-stage low pressure turbine based on noise, weight, and other objectives, and that Kurzke does not provide a reason for a three-stage low pressure turbine and would not be understood as preferring a three-stage low pressure turbine over a two-stage low pressure turbine. *Id.* at 41–42 (citing Mattingly Decl. ¶¶ 82–85, 96). Patent Owner also argues that the cited portions of Kurzke relate to a conventional turbofan engine, do not suggest varying stages in the low pressure turbine of a geared turbofan engine, and caution against their application to geared turbofan engine designs. *Id.* at 43–44 (citing Ex. 1009, 13–15, 17, 20, Table 2, Fig. 4). Patent Owner further argues that Kurzke teaches reducing the number of stages by adding a gearbox. *Id.* at 43–44 (citing Ex. 1009, 17, 18, 20; Mattingly Decl. ¶ 84). Petitioner replies that Patent Owner provides insufficient analysis and evidence that adding stages would emit more noise and that Exhibit 1036 indicates adding a stage would reduce noise. Pet. Reply 23.

Patent Owner's arguments are persuasive. Petitioner has not met its burden of showing that adding booster stages to the fan would have required more low pressure turbine stages.

As for Petitioner's "design choice" rationale, Patent Owner contends that it "may indicate something about what a skilled artisan 'could' have perhaps have done" but none of Petitioner's arguments about what "could" have been done "establish that a person of ordinary skill 'would' have made the proposed combination." PO Resp. 36; *see also id.* at 45–46 (arguing can or could does not lead to concluding one of ordinary skill would have combined references). Patent Owner also asserts that the factors cited by Petitioner are described in Willis as relating to the core, not the low pressure

turbine. *Id.* at 37–40 (citing Ex. 1011, 26, 32, 33, 35, 146, 296, 298, Figs. 8, 9; Ex. 2012; Mattingly Decl. ¶¶ 75, 76, 95).

The record before us indicates, and the parties do not dispute, that a geared gas turbine engine with a two-stage low pressure turbine, such as the one described Willis, and a three-stage low pressure turbine, such as the one described in Kurzke, were known. Thus, such gas turbine engines with two or three stages in their low pressure turbines were within the skill of one of ordinary skill in the art. The record does not indicate that a geared gas turbine engine with a three-stage low pressure turbine presents unexpected results, results in a function different from the prior art, or is not within the ordinary skill in the art. Thus, we are persuaded that claim 10 represents a matter of design choice within the ordinary skill in the art.

Patent Owner also argues that Petitioner's asserted reasons for combining Willis and Kurzke fail to address significant considerations against making the proposed addition of a stage to the low pressure turbine. *Id.* at 36, 46. In particular, Patent Owner contends Willis describes reducing noise and weight of a gas turbine engine that would discourage adding a stage to a low pressure turbine. *Id.* at 46–47 (citing Ex. 1011, 19, 24, 173–212; Ex. 2014, 328:11–329:7). Patent Owner argues that adding a low pressure turbine stage "would likely increase noise emissions," "necessarily would increase weight," and lead to less payload, more engine parts, higher costs, and added complexity, thus deterring the proposed modification. *Id.* at 47–49 (citing Ex. 1011, 19, 24, 26, 92, 293–300; Mattingly Decl. ¶¶ 77, 78, 93, 94).

The record includes insufficient evidence to determine definitively that adding a stage to the low pressure turbine of Willis would prevent Willis

from meeting its low noise goal. Also, the record has insufficient evidence that one of ordinary skill would not look to a gas turbine engine with a three-stage low pressure turbine with its higher weight, parts, costs, and complexity, if it met all the other goals of Willis. To the extent Patent Owner is arguing that Willis would teach away from Petitioner's proposed combination, we find that Willis and Kurzke disclose alternatives to the number of stages in the low pressure turbine and do not criticize, discredit, or discourage a three-stage low pressure turbine.

Patent Owner also contends that Kurzke's low pressure turbine is unsuitable for Willis's engine because Kurzke's low pressure turbine has a larger fan diameter and faster fan blade tip speed but not the variable-pitch fan, variable area fan nozzle, or short takeoff and landing performance required by Willis. PO Resp. 49–50 (citing Ex. 1009, 13–14, 20, Table 2; Mattingly Decl. ¶¶ 79–82, 85–97). Patent Owner further argues that adding a low pressure turbine stage to Willis is complicated and difficult and could affect the gear system, fan, and compressor. PO Resp. 50–51 (citing Ex. 2015, 31:6–12; Mattingly Decl. ¶¶ 86–92). Although we agree that adding a low pressure turbine stage can be complicated, the record persuades us that claim 10 represents a matter of design choice within the ordinary skill in the art.

For the foregoing reasons, a preponderance of the evidence persuades us that Willis and Kurzke would have rendered obvious claim 10.

E. Claim 11

Claim 11 depends from claim 10 and recites "wherein the fan blade tip speed of the fan is greater than 1000 fps." Ex. 1001, 6:58–59. Petitioner cites a portion of Willis that states "low tip speed, 306 m/s (1005 ft/sec)" is a

notable feature. Pet. 59 (citing Abhari Decl. ¶¶ 70, 79–83; Ex. 1011, 38). Petitioner also asserts that Kurzke teaches or suggests a geared turbofan engine with parameters that include a bypass ratio of 14, gear ratio ranging from 2.5 to 3.5, and fan blade tip speed from 1280 fps to 1542 fps. Pet. 53–55 (citing Abhari Decl. ¶¶ 75–76; Ex. 1009, 13, 17, 18).

Patent Owner responds that Willis does not teach or suggest a fan blade tip speed greater than 1000 fps, as required by claim 11 because the cited portion of Willis "provides a preliminary design, not the final fan speeds actually applied by Willis." PO Resp. 52 (discussing Pet. 59; Ex. 1011, 38, 39, Table V, Fig. 11; Ex. 2013, 4–5; Mattingly Decl. ¶¶ 87, 100–101, 103). Patent Owner argues that the "fan in the Willis engine operated below a maximum fan speed less than the claimed 1000 fps." *Id.* at 52, 54–56 (citing Ex. 1011, 34, 92, 96, 97, 150, Table X, Fig. 83; Mattingly Decl. ¶¶ 102–104).

Petitioner replies that Willis is prior art for all it teaches, including engine designs that were not tested, but enabled by Willis. Petitioner also argues that Table V and Figure 11 show a fan tip speed greater than 1000 fps. Pet. Reply 25–26 (citing Ex. 1011, 38, 96, Fig. 11).

We find that Willis teaches or suggests that the "low tip speed, 306 m/s (1005 ft/sec), and the high bypass ratio, 11.3, are notable features." Ex. 1011, 38; *see also* Ex. 1030, 37:18–22 (When asked "is it your opinion that the range of a thousand to 1400 feet per second in Claims 1 and 11 is a range for an actual engine or is it a range for the design process, Dr. Mattingly answered "[i]t's a range for the design process."). The full record persuades us that a preponderance of the evidence shows that Willis teaches

or suggests a fan blade tip speed greater than 1000 fps, as required by claim 11.

V. CONCLUSION

For the foregoing reasons, based on the full record before us, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claims 2, 3, 10, and 11 of the '065 patent are anticipated by Hess and that claims 10 and 11 are unpatentable over Willis and Kurzke.

VI. ORDER

For the reasons given, it is:

ORDERED that claims 2, 3, 10, and 11 of U.S. Patent No. 8,753,065 B2 have been shown, by a preponderance of the evidence, to be unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, the parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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