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Paper 45
Date: June 19, 2014

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAE SYSTEMS INFORMATION AND ELECTRONIC SYSTEMS INTEGRATION, INC.,
Petitioner,

v.

CHEETAH OMNI, LLC,
Patent Owner.

Case IPR2013-00175
Patent 7,633,673 B1

Before STEPHEN C. SIU, JUSTIN T. ARBES, and RAMA G. ELLURU, *Administrative Patent Judges.*

ELLURU, *Administrative Patent Judge.*

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

I. BACKGROUND

Petitioner, BAE Systems Information and Electronic Systems Integration, Inc. ("BAE"), filed a petition on March 4, 2013, requesting *inter partes* review of claims 1, 4, 13–15, 17, and 19 of U.S. Patent No. 7,633,673 B1 ("the '673 patent"). (Paper 1, "Pet."). Patent Owner, Cheetah Omni, LLC ("Cheetah"), filed a preliminary response opposing institution of review. Paper 12. On July 3, 2013, we instituted an *inter partes* review of claims 1, 4, 13–15, 17, and 19 of the '673 patent (Paper 15) ("Dec. on Inst.").

Subsequent to institution, Cheetah filed a Patent Owner Response (Paper 27) ("PO Resp."), and BAE filed a Reply (Paper 30) ("Pet. Reply"). Along with its Patent Owner Response, Cheetah filed a Motion to Amend (Paper 28) ("Mot."). BAE filed an Opposition to Cheetah's Motion to Amend (Paper 31) ("Opp."), and Cheetah filed a Reply in support of its Motion (Paper 32) ("PO Reply"). BAE initially requested an oral hearing, which we granted, and Cheetah did not file a request for oral argument. Papers 43, 44. BAE subsequently contacted the Board to indicate its belief that a hearing was not necessary. Paper 44. Based on the parties' representations, we determined that a hearing was not necessary for a decision in this trial. *Id*.

The Board has jurisdiction under 35 U.S.C. § 6(c). 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 BAE has shown by a preponderance of the evidence that claims 1, 4, 13–15, 17, and 19 of the '673 patent are unpatentable, and we deny Cheetah's Motion to Amend.

A. The '673 Patent

The '673 patent is directed to systems and methods for generating infrared light with wavelength in the mid-infrared (IR) range. Ex. 1001, Title, Abstract. Some of the embodiments described by the '673 patent use a Raman wavelength shifter that is coupled to a pump laser to produce a longer wavelength. Ex. 1001, 14:65–67. A "Raman wavelength shifter" refers to any device that uses the Raman effect to shift a shorter optical signal wavelength to a longer optical signal wavelength. Ex. 1001, 15:1–3. "Raman effect" is caused by inelastic scattering of a photon during an interaction with an atom or molecule, causing the photon to gain or lose energy with a corresponding decrease or increase in wavelength, respectively. Pet. 13 (citing Ex. 1013).

B. Challenged Claims

Claims 1 and 13 are independent claims. The remaining challenged claims depend from either claim 1 or claim 13. Claim 1 is representative of the challenged claims and is reproduced below.

> 1. A mid-infrared light source, comprising:
>
> a multiplexer operable to combine a first laser signal and a second laser signal to generate a first optical signal, the first optical signal comprising one or more wavelengths;
>
> a gain fiber coupled to the multiplexer and operable to receive at least the first optical signal, the gain fiber comprising a first waveguide structure;
>
> a second waveguide structure coupled to the gain fiber and operable to wavelength shift at least one wavelength of the first optical signal to a longer wavelength optical signal, the longer wavelength optical signal comprising a wavelength in the range of 1.7 microns or more, the second waveguide structure comprising a wavelength shifting fiber coupled to a nonlinear element, wherein the wavelength shifting fiber operates to wavelength shift the at least one wavelength of the first optical signal to a second optical wavelength

> and the nonlinear element operates to wavelength shift the second optical wavelength to the longer wavelength optical signal, and wherein the wavelength shifting fiber is substantially different than the nonlinear element.

C. Prior Art

The pending grounds of unpatentability in this *inter partes* review are based on the following prior art.

Patent No.	Filing Date	Issue Date	Exhibit No.
6,229, 828 ("Sanders")	July 27, 1998	May 8, 2001	1010

Pet. 8. BAE also relies on a declaration submitted by David A. Smith, Ph.D. ("Smith Decl.") (Ex. 1011).

D. Pending Grounds of Unpatentability

We instituted an *inter partes* review of the '673 patent based on the following grounds:

1. Claims 1, 4, 13, 15, 17, and 19 as anticipated by Sanders under 35 U.S.C. § 102(b); and
2. Claim 14 as unpatentable over Sanders under 35 U.S.C. § 103(a).

Dec. on Inst. 20.

II. ANALYSIS

A. Claim Construction

Consistent with the statute and the legislative history of the AIA, the Board interprets claims by applying the broadest reasonable construction in the context of the specification in which the claims reside. 37 C.F.R. § 42.100(b); *see* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012). The words of the claim will be given their plain meaning unless the plain meaning is inconsistent with the specification. *In re Zletz*, 893 F.2d 319, 321 (Fed. Cir. 1989). "There are only two exceptions to the general rule that a claim term is given its ordinary meaning: 1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution." *See Thorner v. Sony Computer Entm't Am. LLC,* 669 F.3d 1362, 1365 (Fed. Cir. 2012). "Although an inventor is indeed free to define the specific terms used to describe his or her invention, this must be done with reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Also, we must be careful not to read a particular embodiment appearing in the written description into the claim if the claim language is broader than the embodiment. *See In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993) ("limitations are not to be read into the claims from the specification").

1. "Gain fiber"

Independent claims 1 and 13 require "a gain fiber coupled to the multiplexer and operable to receive at least the first optical signal."

In our Decision to Institute, based on testimony by BAE's declarant and the '673 patent Specification, we interpreted "gain fiber" in claims 1 and 13 as "an

optical fiber that functions as a gain medium (*i.e.*, amplifies an input signal)." Dec. on Inst. 10.

Cheetah argues that our construction improperly narrows the claims. PO Resp. 3, 12. In support, Cheetah states that the claim language contains no limitation indicating that the gain fiber is functioning as a gain medium. *Id*. at 12. According to Cheetah, the patentee has acted at least partially as his own lexicographer. *Id*. at 13. Cheetah points to disclosure from the '673 patent Specification stating that "a gain fiber 804 [is] operable to facilitate shifting pump signal 810 to a desired wavelength," "[g]ain fiber 804 may comprise any waveguide structure capable of wavelength shifting pump signal 810 to a longer wavelength," and "[i]n this particular embodiment, gain fiber 804 comprises an optical fiber." *Id*. at 12–13 (citing Ex. 1001, 17:18–27). With respect to the part of our construction "(i.e., amplifies an input signal)," Cheetah notes that the '673 patent Specification does not contain the terms "amplify or "amplifies." *Id*. at 13.

Cheetah's proposed construction for "gain fiber" is "an optical fiber comprising any waveguide structure." *Id*. at 14. According to Cheetah, its proposed construction includes language from the Specification, and is broad enough to include the teachings in the Specification and the understanding of a person of ordinary skill in the art as attested to by BAE. *Id*.

BAE responds that Cheetah's proposed construction renders the term "gain" surplusage because that construction does not require amplification of the input signal. Pet. Reply 9–10 (citations omitted). Further, BAE notes that the '673 patent Specification states that "gain fiber 804" is a "gain medium." *Id*. at 10. Cheetah does not address this disclosure from the specification. *See* PO Resp. 12–13.

Cheetah's proposed construction is incorrect because the '673 patent Specification does not limit "gain fiber" to a waveguide structure, but rather discloses that a gain fiber "may comprise" any waveguide structure. Ex. 1001, 17:18–27. We further agree that Cheetah's proposed construction for "gain fiber" would read out the term "gain."[1] *See* Pet. Reply 9–10. BAE's declarant states that "gain fiber" would have been understood by a person of ordinary skill in the art to mean "an optical fiber that operates to amplify an input signal." Ex. 1011 ¶ 22. Cheetah does not contest this testimony. *See* PO Resp. 13. As we noted in our Decision (Dec. on Inst. 10), the '673 patent Specification's disclosure of "gain fiber" is consistent with this ordinary meaning. In particular, the '673 patent Specification refers to "[g]ain fiber 804" as a "gain medium." Ex. 1001, 17:18–27, 17:42. As Cheetah notes, however, the '673 patent Specification states that the gain fiber is "operable" to facilitate shifting a signal to a desired wavelength. *Id*. at 17:18–27.

Accordingly, we modify our initial construction of "gain fiber," and interpret the term to mean "an optical fiber that is operable as a gain medium (*i.e.*, amplifies an input signal)."

2. Other Terms

In the Decision on Institution, we interpreted one other claim term as follows. We interpreted "wavelength shift," appearing in claims 1 and 13, as "receiving at least one input wavelength and emitting at least one output wavelength that is different from the input wavelength." Dec. on Inst. 10–11. Neither party disputes that interpretation, and we apply it in this decision, for the reasons stated in the Decision on Institution.

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[1] Moreover, as discussed below, even if we were to adopt Cheetah's proposed construction of "gain fiber," it would not change our analysis.

B. Anticipation by Sanders (Ex. 1010)

With respect to our review of BAE's contention that claims 1, 4, 13, 15, 17, and 19 are anticipated by Sanders, we have reviewed BAE's Petition, Cheetah's Patent Owner Response, and BAE's Reply, as well as the evidence discussed in each of those papers. We are persuaded by a preponderance of the evidence that claims 1, 4, 13, 15, 17, and 19 are anticipated by Sanders. *See* Pet. 15–27, 28–30, 32–44 (claim charts).

Claim 13

Cheetah argues that Sanders's nonlinear frequency mixing ("NFM") device (element 114 of Figure 19) does not satisfy the claimed "nonlinear oscillator" of independent claim 13, and thus, Sanders does not anticipate claims 13 or its dependent claims. PO Resp. 3, 8. Claim 13 recites "the wavelength shifting structure comprising a wavelength shifting fiber coupled to a nonlinear oscillator." Cheetah also notes that claim 4, depending from claim 1, further limits the recited "nonlinear element" of claim 1 to be a "nonlinear oscillator." *Id*.

BAE contends that Sanders's NFM device 114, illustrated in Figure 19, corresponds to the recited "nonlinear oscillator" of claim 13. Pet. 26. BAE notes that Sanders states that NFM device 114 shown in Figure 19 may be a quasi-phase matching (QPM) optical parametric *oscillation* (OPO) device. *Id*. (citing Ex. 1010, 21:1–3) (emphasis added); *see* Ex. 1010, 8:13–14. Sanders expressly states the following.

> The combined outputs of wavelengths λ_1 and λ_2 from Raman fiber oscillator 112 is provided as input to NFM device 114, e.g., QPM DFM or QPM OPO devices.

Ex. 1010, 21:1–3. Figure 19 of Sanders is reproduced below.

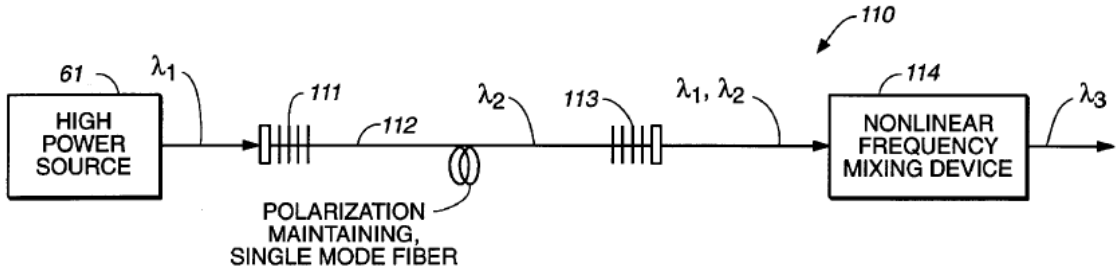
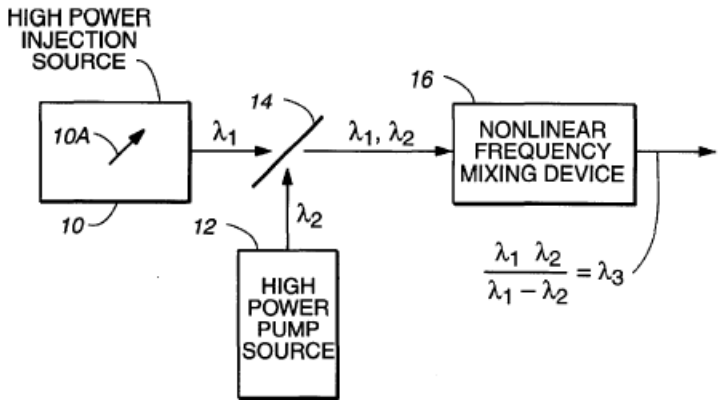


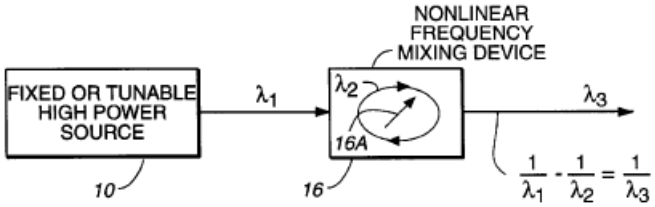
Figure 19 illustrates NFM device 114.

Cheetah argues that Sanders's NFM device 114 is a QPM difference frequency mixing ("DFM") device, not a QPM OPO device, as BAE asserts. PO Resp. 3–8. Cheetah states that a QPM DFM device accepts light at two wavelengths and mixes them to produce light at a third wavelength (two input wavelengths and one output wavelength), whereas a QPM OPO device accepts light at one wavelength and mixes it with internally generated light at a second wavelength to produce light at the third wavelength (one input wavelength and one output wavelength). PO Resp. 5–6. Cheetah states that a NFM device comprising a QPM DFM device is illustrated in Figure 1A of Sanders. *Id*. at 4 (citing Ex. 1010, 6:50–7:13); *see* Ex. 1016 ¶ 4. Figure 1A of Sanders is reproduced below.



Sanders explains that Figure 1A illustrates a NFM device comprising a QPM DFM device wherein beams λ_1 and λ_2 from two different light sources are combined and

provided as input to QPM DFM device 16, which generates a frequency mixed beam having wavelength λ_3. Ex. 1010, 6:50–7:13. Cheetah states that a NFM device comprising a QPM OPO device is illustrated in Figure 1D. PO Resp. 5 (citing Ex. 1001, 8:8–20); *see* Ex. 1016 ¶ 4. Figure 1D is reproduced below.



Sanders explains, with respect to Figure 1D, that pumping source 10 having a pumping wavelength λ_1 is coupled to NFM device 16 comprising a QPM OPO device, which functions as an "oscillator creating within its optical cavity a second shifted wavelength, λ_2, which is difference frequency mixed" with pumping wavelength λ_1 to produce wavelength λ_3. Ex. 1010, 8:8–20.

According to Cheetah, the NFM device of Figure 19 is an embodiment of a QPM DFM, illustrated in Figure 1A because there are two input wavelengths, λ_1 and λ_2. PO Resp. 6-7. Cheetah emphasizes (*id.*) the following disclosure from Sanders relating to Figure 19.

> The output from Raman fiber oscillator 112 is coupled into NFM device 114 for mixing of combined wavelengths λ_1, λ_2, i.e., is the difference between the Raman shifted beam and the transmitted pump beam from source 61.

Ex. 1010, 21:9–13. Thus, according to Cheetah, NFM device 114 has light at λ_1 and λ_2 as its input, and mixes them to produce light at wavelength λ_3. PO Resp. 7. According to Cheetah, it is consistent with Figure 1A for Sanders to state that NFM device 114 could be a QPM DFM device, but that it was a "drafting error" to imply that NFM device 114 could be a QPM OPO because Sanders does not teach a QPM OPO that mixes two inputs λ_1 and λ_2. *Id.*

Cheetah further argues that Figure 15 of Sanders affirms that a QPM OPO device mixes one input at λ_1 with internally generated light at λ_2. *Id*. at 7–8. Figure 15 of Sanders is reproduced below.

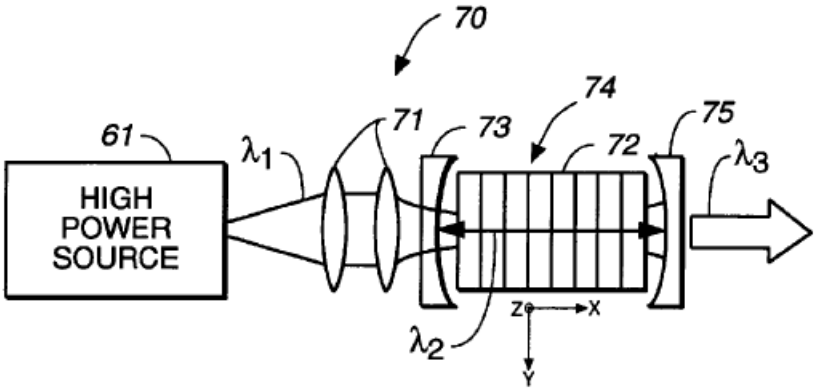


Figure 15 includes QPM OPO device 74. Ex. 1010, 18:48–65. Sanders states that wavelength λ_1 is coupled into OPO resonator 74, which includes external cavity focusing mirrors 73 and 75. *Id*. Mirror 73 is transparent to wavelength λ_1, but is highly reflective of internally developed wavelength λ_2, whereas mirror 75 is transparent to developed wavelength λ_3, and highly reflective of internally developed wavelength λ_2. *Id*. Thus, contends Cheetah, the NFM components of Figures 15 and 19 are not combinable because inserting the Figure 15 QPM OPO into the Figure 19 system results in the Figure 19 λ_2 being reflected back into the fiber by mirror 73 and discarded. PO Resp. 8. Cheetah states that "[i]n no case would the QPM OPO of Fig. 15 mix λ_1 with Fig. 19 λ_2." *Id*.

We agree with BAE that Cheetah's attorney argument is not persuasive. *See* Pet. Reply 1. Instead, we are persuaded by the express disclosure of Sanders that NFM device 114 may be a QPM DFM or QPM OPO device, and do not view that express disclosure as merely a drafting error, as Cheetah suggests. Ex. 1010, 21:1–3 ("NFM device 114, e.g., QPM or QPM OPO devices"). We further find persuasive BAE's testimony from Dr. David A. Smith that a person of ordinary skill in the art would understand that a QPM DFM device and QPM OPO device

operate fundamentally in the same way—"by mixing two wavelengths to generate a third wavelength," and only differ with regard to the source of the second wavelength. Ex. 1016 ¶ 4. Dr. Smith's uncontested testimony is that a person of ordinary skill in the art would recognize that NFM device 114, illustrated in Figure 19, can function as a QPM OPO device (as Sanders expressly states) by using wavelength λ_2 as the input wavelength to NFM device 114, internally generating another wavelength λ_4 (not shown), and mixing λ_2 with λ_4 to generate λ_3. Ex. 1016 ¶ 6.[2]

Dr. Smith further refers to Figure 15[3] to explain that the additional input wavelength λ_1, as illustrated in Figure 19, would not adversely affect the conversion of the wavelength λ_2 by the NFM device functioning as a QPM OPO device. *Id*. According to Dr. Smith, the QPM OPO device, illustrated as element 74 in Figure 15, may include crystal 72 for phase matching the input wavelength. *Id*. (citing Ex. 1010, 18:57–60). For example, asserts Dr. Smith, crystal 72 could be designed to receive the second wavelength λ_2 (1.44 μm), generate the internal wavelength λ_4 (e.g., 2.25 μm), and mix λ_2 with λ_4 to generate the third wavelength λ_3 (e.g., 4.0 μm). *Id*. (citing Ex. 1010, 19:3–9, 2:59–62, 7:63–67). As Dr. Smith explains, a person of ordinary skill in the art would understand that λ_1 would have no effect on the wavelength conversion from λ_2 to λ_3, because phase matching would not occur for λ_1 if crystal 72 was designed to phase match with wavelength λ_2. *Id*. Thus, we determine that Sanders discloses NFM device 114, illustrated in

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[2] BAE notes that in Figures 1D and 15 of Sanders, the input wavelength to the NFM device is λ_1, the mixing wavelength is λ_2, and the NFM output wavelength is λ_3, whereas in Figure 19 the input wavelength is λ_2, the mixing wavelength is λ_4 (not shown), and the NFM output wavelength is λ_3. Pet. Reply 3 n.1.

[3] Figure 15 is a NFM device that operates as a QPM OPO device. Ex. 1010, 18:46–49.

Figure 19 of Sanders, as a QPM OPM device. Cheetah has not disputed that a QPM OPM device satisfies the claimed "nonlinear oscillator" of independent claim 13.

Cheetah further argues that Sanders does not disclose the limitations that "the wavelength shifting fiber operates to wavelength shift the at least one wavelength . . . to a second optical wavelength," and that "the nonlinear oscillator operates to wavelength shift the second optical wavelength" to a third wavelength, as recited in claim 13. PO Resp. 10. Cheetah asserts that Sanders discloses shifting only "a portion" of the radiation beam at wavelength λ_1 from the pump source to a second wavelength λ_2, and that the output from Raman fiber oscillator 112 is coupled into NFM device 114 for "'mixing of combined λ_1, λ_2.'" *Id*. (quoting Ex. 1010, 20:63–21:11) (emphasis omitted). Cheetah contends that Sanders teaches a different system than the one recited in claim 13, where Raman fiber oscillator 112 shifts only a portion of its input wavelength because NFM mixing device 114 needs both λ_1 and λ_2. *Id*. at 11.

We are not persuaded by Cheetah's argument. Cheetah has not shown that the limitations require shifting the *entire* wavelength, as opposed to *a portion* of the wavelength, as admittedly disclosed by Sanders. *See id*. at 10–11. Furthermore, Cheetah's argument that Sanders discloses a NFM device that mixes two input wavelengths, λ_1 and λ_2, as opposed to a nonlinear oscillator that shifts a second wavelength to a third wavelength as claimed, is based on its assertion that NFM device 114 is a QPM DFM device (*id*. at 11). As discussed above, we determine that NFM device 114 is not limited to a QPM DFM device.

Furthermore, our construction of "gain fiber" does not affect our finding that Sanders discloses the claimed "gain fiber." Dec. on Inst. 12–13. As we found in

our Decision on Institution, fiber amplifier 69A, illustrated in Figure 11,[4] receives the optical signal from the beam combiner 67A, amplifies the signal, and further guides the received signal into the inner cladding 69C and core 69B of first amplifier 69A, and thus, satisfies the "gain fiber" limitation. *See* Ex. 1010, Fig. 11, 16:22–28, 17:12–19.

Claim 1

Claim 1 recites "the nonlinear element operates to wavelength shift the second optical wavelength to the longer wavelength optical signal." Cheetah argues that Sanders does not anticipate claim 1 based on the same arguments asserted in support of claim 13. Specifically, Cheetah contends that Sanders does not teach the claimed "nonlinear element" of claim 1. PO Resp. 11. For the reasons discussed above, we do not find those arguments persuasive.

BAE further contends that even if the NFM device 114 of Figure 19 is a QPM DFM device, it corresponds to the recited "nonlinear element" of claim 1. Pet. Reply 7–8. We agree. Sanders explains that the output from fiber oscillator 112, λ_1 and λ_2, is input into NFM device 114 for mixing of the combined wavelengths to output a resulting wavelength. Ex. 1010, 21:9–18. As an example, wavelength λ_1 may be between about 1030 nm to 1090 nm, and wavelength λ_2 may be between about 1.44 μm, and the resulting wavelength after mixing will be a mid-IR wavelength between about 3.6 nm and 4.5 nm.[5] *Id*. at 21:13–18. BAE asserts that as its name indicates, the "nonlinear" frequency mixing device, i.e.,

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[4] High power source 61 illustrated in Figure 11, which includes fiber amplifier 69A, is incorporated into Figure 19. Ex. 1010, Figs. 11, 19.

[5] BAE notes that there is a typographical error in Sanders because although Sanders states that the resulting wavelength after mixing is between approximately 3.6 nm and 4.5 nm, Sanders states that the resulting wavelength is a "mid-IR wavelength," and thus, the units are μm, and not nm. Pet. Reply 8 n.4 (citing Ex. 1010 at 21:17–18).

NFM device 114, is a "nonlinear element," as recited in claim 1, and it shifts wavelength λ_2 from approximately 1.44 μm to a longer wavelength of approximately 3.6 μm to 4.5 μm. Pet. Reply 8. Dr. Smith's testimony supports BAE's argument that NFM device 114 satisfies the "nonlinear element" recited in claim 1. Ex. 1011 ¶ 33. Therefore, we determine that BAE has shown by a preponderance of the evidence that even if NFM device 114 is a QPM DFM device, it satisfies the recited "nonlinear element" of claim 1.

BAE's Reply also refers to Figure 20 of Sanders as describing all of the limitation of claims 1, 4, 13, 15, 17, and 19. Pet. Reply 5–7. Although BAE cited Figure 20 in its Petition, it did not develop this particular argument in its Petition. *See e.g.*, Pet. 20, 32–35 (claim chart for claim 1 showing that Sanders discloses the limitations of claims, 1, 4, 13, 15, 17, and 19). Thus, given that this is a newly raised argument, we decline to consider this argument in this decision. *See* 37 C.F.R. § 42.23(b) ("A reply may only respond to arguments raised in the corresponding opposition or patent owner response.")

Conclusion

Accordingly, based on the record evidence, in light of the arguments presented, BAE has shown, by a preponderance of the evidence, that independent claims 1 and 13, as well as claims 4, 15, 17, and 19 depending therefrom, are anticipated by Sanders.

C. Obviousness Over Sanders (Ex. 1010)

With respect to our review of BAE's contention that claim 14 is rendered obvious by Sanders, we have reviewed BAE's Petition, Cheetah's Patent Owner Response, and BAE's Reply, as well as the evidence discussed in each of those papers. Cheetah does not raise any arguments with respect to BAE's challenge that claim 14 is rendered obvious by Sanders. *See* PO Resp. 2–3. We are

persuaded, by a preponderance of the evidence, that claim 14 would have been obvious over Sanders. *See* Pet. 40–41 (claim charts).

D. Cheetah's Motion to Amend

Cheetah filed a Motion to Amend Claims. In its motion to amend, Cheetah proposes substitute claims 21–26, to replace claims 1, 4, 13, and 15. Mot. 2. Cheetah's motion is contingent, meaning that a proposed substitute claim is at issue and would be considered only if the claim it replaces, i.e., an original claim or a prior proposed substitute claim, is found unpatentable. *Id*. Specifically, Cheetah proposes the following.

> If [claim 1] is found unpatentable, please replace claim 1 with substitute claim 21. If substitute claim 21 is found unpatentable, please replace claim 1 . . . with substitute claim 22. If claims 21 and 4 are both found unpatentable, please replace claim 4 with substitute claim 23. If claim 13 is found unpatentable, please replace claim 13 with substitute claim 24. If substitute claim 24 is found unpatentable, please replace claim 13 . . . with substitute claim 25. If claims 24 and 15 are found unpatentable, please replace claim 15 with substitute claim 26.

Id. Because we have determined that original claims 1 and 13 are unpatentable, we reach the merits of Cheetah's motion.

As the moving party, Cheetah bears the burden of proof to establish that it is entitled to the relief requested. 37 C.F.R. § 42.20(c). Entry of the proposed amendments is not automatic, but only upon Cheetah having demonstrated the patentability of those claims.

Cheetah's proposed substitute claims 21 and 22 are illustrative of the proposed substitute claims. Substitute claims 21 and 22, with the new claim language added to original claim 1 underlined, are reproduced below.

21. A mid-infrared light source, comprising:

a multiplexer operable to combine a first laser signal and a second laser signal to generate a first optical signal, the first optical signal comprising one or more wavelengths;

a gain fiber coupled to the multiplexer and operable to receive at least the first optical signal, the gain fiber comprising a first waveguide structure;

a second waveguide structure coupled to the gain fiber and operable to wavelength shift at least one wavelength of the first optical signal to a longer wavelength optical signal, the longer wavelength optical signal comprising a wavelength in the range of 1.7 microns or more, the second waveguide structure comprising a wavelength shifting fiber coupled to a Q-switcher further coupled to a nonlinear element, wherein the wavelength shifting fiber operates to wavelength shift the at least one wavelength of the first optical signal to a second optical wavelength and the nonlinear element operates to wavelength shift the second optical wavelength to the longer wavelength optical signal, and wherein the wavelength shifting fiber is substantially different than the nonlinear element.

22. A mid-infrared light source, comprising:

a multiplexer operable to combine a first laser signal and a second laser signal to generate a first optical signal, the first optical signal comprising one or more wavelengths;

a gain fiber coupled to the multiplexer and operable to receive at least the first optical signal, the gain fiber comprising a first waveguide structure;

a second waveguide structure coupled to the gain fiber and operable to wavelength shift at least one wavelength of the first optical signal to a longer wavelength optical signal, the longer wavelength optical signal comprising a wavelength in the range of 1.7 microns or more, the second waveguide structure comprising a wavelength shifting fiber coupled to a Q-switcher further coupled to a nonlinear element, wherein the wavelength shifting fiber operates to wavelength shift the at least one wavelength of the first optical signal to a second optical wavelength and the nonlinear element operates to wavelength shift the second optical wavelength to the longer wavelength optical signal, ~~and~~ wherein the wavelength shifting fiber is substantially different than the nonlinear element, and wherein the

> Q switcher produces an output signal having a pulse width in the range of two (2) nanoseconds to one hundred (100) milliseconds.

1. Written Description Support

Cheetah's substitute claim 21 is identical to original claim 1, except for the additional recital that the second waveguide structure comprises "a wavelength shifting fiber coupled to a Q-switcher further coupled to a nonlinear element." Substitute claim 22 adds the same limitation, and also adds the limitation "and wherein the Q switcher produces an output signal having a pulse width in the range of two (2) nanoseconds to one hundred (100) milliseconds." Mot. 3–7.

In its motion, Cheetah contends that the subject matter of its proposed substitute claims have written description support in the specification of the '673 patent. Mot. 7. Rules 42.121(b)(1) and (2), however, require that a motion to amend set forth the support in the *original disclosure* of the patent for each claim that is added and the support in an *earlier-filed disclosure* for each claim for which the benefit of the filing date of the earlier filed disclosure is sought. 37 C.F.R. § 42.121(b)(1), (2). For written description support for the proposed substitute claims, Cheetah refers to portions of the '673 patent Specification only for the added limitations in its proposed substitute claims. Specifically, Cheetah refers to Figure 8D, and column 19, lines 20–39 of the '673 patent Specification. Mot. 7. Such reference does not satisfy the requirements of Rule 42.121(b)(1) because the specification is not the original disclosure. Moreover, Cheetah cites alleged support in the specification for *only* the added Q-switcher limitations. Cheetah does not identify support in the original disclosure "for each claim" in its motion to amend, as a whole and including the Q-switcher limitations, as required by Rule 42.121(b)(1). Cheetah, therefore, has not made a sufficient showing that its

proposed substitute claims, as a whole, have written description support in the original disclosure of the ’673 patent, and we deny the motion on that basis.

2. Patentability of Substitute Independent Claims 21 and 24

Even if Cheetah had satisfied the requirement to show sufficient written description support, it has not shown that proposed substitute claims 21 and 24 are patentable. In its motion, Cheetah states that in the related litigation in the United States Court of Federal Claims, BAE provided Cheetah with prior art references. Mot. 9.[6] Cheetah asserts that it searched those prior art references for the term “Q switch,” and argues that those references disclose broad coverage of the use of Q-switchers, at a different point in their disclosed devices and for different purposes than those of the ’673 patent. *Id*. According to Cheetah, those references teach using Q-switchers within laser sources (e.g., Sanders’s Fig. 11, element 66A) or within a pump laser source (e.g., Sanders’s Fig. 11, element 65A). *Id*. at 10–11.

We are not persuaded, however, that Cheetah has met its burden to show that proposed substitute claims 21 and 24 would have been unpatentable over the prior art. BAE, in opposing Cheetah’s motion, cites the following additional prior art reference in addition to Sanders (Ex. 1010): G.P. Lees, 980 nm diode pumped erbium^{3+}/ytterbium^{3+} doped Q-switched fibre laser, Electronic Letter, Vol. 31, No. 21, 1836–37 (October 1995) (“Lees”) (Ex. 1018). Opp. 7. BAE argues that Sanders and Lees, in combination, teach all of the limitations of claims 21 and 24, and that a person of ordinary skill in the art would have had reason to modify Sanders to incorporate a Q-switcher in the recited position, as taught by Lees. *Id*.

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[6] We note that distinguishing the proposed claims only from the prior art references applied to the original patent claims is insufficient to demonstrate patentability over the prior art. *See Idle Free Sys. v. Bergstrom, Inc.*, IPR2012-00027, Paper 26 at 7 (June 11, 2013) (patent owners must consider and distinguish “prior art,” both “of record” and “not of record but known to the patent owner”).

7–13. BAE's arguments are supported by the testimony of Dr. David A. Smith. *See* Ex. 1017 ¶¶ 5–11.

Q-Switcher

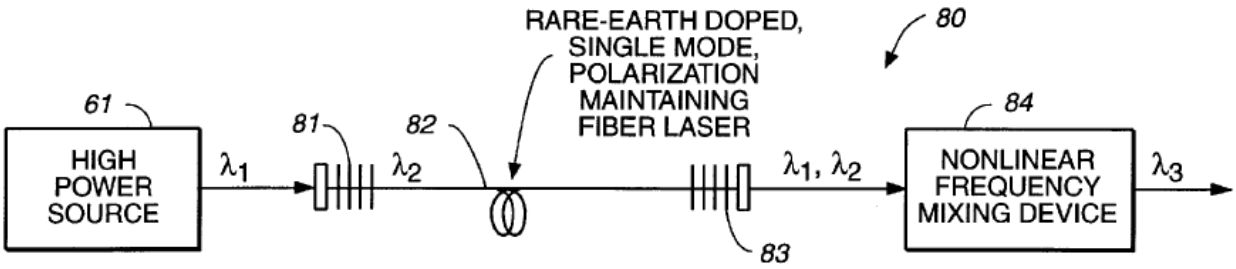
Cheetah refers to the following disclosure from U.S. Patent No. 7,286,587 (Ex. 2009) for a description of a Q-switcher. Mot. 8.

> Q-switching is a technique used to obtain high peak power laser pulses. Q-switching is performed by controlling Q-switching oscillation to modulate the losses in a resonator cavity 11 by abruptly changing a loss of resonant laser light passing through resonator cavity 11. Acousto-optic Q-switches are well known in the art, are often made from fused silica or crystal quartz, and are powered from an RF source connected to a transducer mounted to the silica substrate of the Q-switch.

Ex. 2009, 5:42–50.

Sanders

Figure 16 of Sanders shows a mid-IR light source that uses high power source 61 and is similar to the mid-IR light source shown in Figure 19, which we discussed above. Ex. 1010, Figs. 16, 19. In particular, Figure 16 includes the same components as Figure 19, except that fiber oscillator 112 of Figure 19 is replaced by fiber laser 82 of Figure 16. *Id*. at 19:10–15, 22:23–25. Figure 16 of Sanders is reproduced below.



Sanders explains in relation to Figure 16 that if the first wavelength λ_0 from fiber amplifier 69A is approximately 910 nm, fiber laser 82 shifts the first wavelength λ_1 to a second wavelength λ_2 of approximately 1155 nm. *Id*. at 19:41–49. We, thus, agree with BAE (Opp. 9) that fiber laser 82 is a "wavelength shifting fiber" as recited in proposed claims 21 and 24. Further, fiber laser 82 is coupled to NFM device 84, which shifts the second wavelength λ_2 to a longer wavelength λ_3 in the mid-IR region, such as approximately 4.3 μm. *Id*. at 19:29–33, 41–49, 55–62. Sanders states that NFM device 84 may be a QPM OPO device. *Id*. at 20:7–8. Accordingly, based on the disclosure of Sanders and our discussion above as to how NFM device 114 in Figure 19 describes a QPM OPO device, we agree with BAE (Opp. 9–10) that NFM device 84 is a "nonlinear oscillator" as recited in proposed substitute claim 24, and a "nonlinear element" as recited in proposed substitute claim 21.

Lees

Lees describes a fiber laser that includes an Er:Yb codoped fiber surrounded by an input mirror and an output mirror. Ex. 1018, p. 1836 (right hand column, first full paragraph); Fig. 1. In order to "Q-switch" the laser, an acousto-optic modulator (AOM) is introduced into the laser cavity between an end of the fiber and the output mirror. *Id*. at Fig. 1; p. 1836 (right hand column, third full paragraph). The Q-switched fiber laser provides laser pulses having a peak power over 50 W, with a pulse width of 15 ns and a pulse repetition rate of 500 Hz. *Id*.

Analysis

We are persuaded by BAE's arguments (Opp. 11) that it would have been obvious to a person of ordinary skill in the art to modify Sanders to couple a Q-switcher with fiber laser 82 shown in Figure 16 based on the teachings of Lees. *See* Ex. 1017 ¶¶ 8–11. As Cheetah acknowledges (Mot. 8), Q-switchers were

known in the art and used to obtain high peak power laser pulses. Lees teaches a Q-switcher, the AOM, within the laser cavity of the Er:Yb fiber laser. Ex. 1018, Fig. 1; p. 1836 (right hand column, first full paragraph); Ex. 1017 ¶ 9. Sanders explains that high peak power laser pulses are advantageous for pumping a QPM OPO device, such as Sanders's NFM device 84. Ex. 1010, 1:40–44, 3:21–27, 17:42–49. We, thus, are persuaded by Dr. Smith's testimony that it would have been obvious to a person of ordinary skill to provide high peak power pulses to NFM device 84 by arranging Lees's AOM (i.e., a Q-switcher) within Sanders's fiber laser 82 in a manner described by Lees. Ex. 1017 ¶¶ 9–10. As BAE asserts, the reason to combine would have been to provide high peak power laser pulses from fiber laser 82 to NFM device 84. *See id*. ¶¶ 9–11. We further are persuaded that there would have been a reasonable expectation of success for modifying Sanders based on Lees, in view of the similarities between the fiber laser 82 of Sanders and the Q-switched fiber laser of Lees. *See id*. ¶¶ 10–11.

Cheetah, in its Reply to BAE's opposition to the motion to amend, argues that the substitute claims are non-obvious over the combination of Sanders and Lees. PO Reply 4–6. In support of its Reply, Cheetah submits the declaration testimony of Dr. Erich Ippen. Ex. 2013.[7] Cheetah summarily asserts that Dr. Ippen shows that the combination proposed by BAE would not work because light beam λ_2 is generated only to be reflected back at reflector 73. PO Reply 5.

Cheetah has not directed us to sufficient evidence to demonstrate that substitute claims 21 and 24 would not have been obvious over the combination of

[7] Patent Owner was authorized to file a replacement declaration from Dr. Ippen as supplemental evidence. Paper 35 at 4. Cheetah asserts that the replacement declaration, Exhibit 2013, is identical to Exhibit 2010 except for portions of the text being blacked out, a different date, and Dr. Ippen's newly affixed signature indicating that he has reviewed and approved Exhibit 2013. Paper 36 at 2.

Sanders and Lees. First, the Board has made clear, and we agree, that "a party may not make its case within the declaration of an expert and state in the motion itself that readers simply should refer to the presentation in the declaration." *ZTE Corp. v. Contentguard Holdings, Inc.*, IPR2013-00136 (Paper 31 at 2) (Nov. 5, 2013). It is improper for any argument to be fully developed and presented, not in the party's paper itself, but in the declaration of an expert. *Id*. at 2–3. Here, Cheetah's Reply does not present any argument as to why the combination proposed by BAE would not work, but rather merely cites to the declaration of Dr. Ippen. PO Reply 5; *see* 37 C.F.R. § 42.6(a)(3) (arguments must not be incorporated by reference from one document into another document). Second, Dr. Ippen's contentions that the proposed combinations would not work refer to the reflection of λ_2 by reflector 73, which is located in Figure 15, while BAE's proposed combination refers to Figure 16 of Sanders. *See* Ex. 2010 ¶ 8; Opp. 8–10. The wavelength λ_2 illustrated in Figure 15[8] is the internal wavelength generated by QPM OPO NFM device 74 (Ex. 1010, 18:46–63), whereas in Figure 16, the internally generated wavelength by NFM device 84, when it is functioning as a QPM OPO device, is not shown. Opp. 9 (asserting that the internally generated wavelength by NFM device 84 is λ_4); Ex. 1017 ¶¶ 5–6. Wavelength λ_2 in Figure 16 is the input wavelength to NFM device 84. *See* Opp. 9. In other words, BAE's proposed combination does not bodily incorporate the embodiment of Figure 15 into Figure 16 (*see* Ex. 2010 ¶ 6) such that the reference to λ_2 in each embodiment refers to the same wavelength.

Cheetah further contends that even if the proposed combination could work, it would be "highly inefficient because λ_2 is generated but put to no gainful use." PO Reply 5 (citing Ex. 2010 ¶ 9). We likewise are not persuaded by this

[8] BAE refers to Figure 15 of Sanders to show a NFM device that functions as a QPM OPO device. Pet. Reply 3–4 n.1; Opp. 9–10.

argument. A combination of teachings that results in an inefficient system still may render a claim obvious, provided there was a reason for a person of ordinary skill in the art to have made the combination. *See In re Farrenkopf*, 713 F.2d 714, 716-17 (Fed. Cir. 1983) (where a prior art reference taught the addition of inhibitors as the most convenient, but costliest, solution to a particular problem, the court held that the additional expense would not have discouraged one of ordinary skill in the art from seeking the convenience expected therefrom). As discussed above, we are not persuaded that wavelength λ_2, as illustrated in Figure 16, has no gainful use, and BAE has put forth a sufficient reason to combine the teachings of Sanders and Lees, as explained above. Lastly, Cheetah contends that BAE's proposed combination does not render the substitute claims obvious because wavelength λ_2, which Cheetah equates with the recited "second optical wavelength," is discarded. PO Reply 5. As stated above, we are not persuaded by this argument.

Based on the foregoing discussion, Cheetah has not met its burden to demonstrate that claims 21 and 24 would have been unpatentable over the combination of Sanders and Lees.

<u>Patentability of Substitute Claims 22 and 25</u>

Cheetah proposes substituting claim 1 with claim 22 if substitute claim 21 is found unpatentable and substituting claim 13 with claim 25 if substitute 24 is found unpatentable. Mot. 2. Cheetah acknowledges that it has provided two substitute claims for original claim 1 and two substitute claims for original claim 13. *Id*. at 12. Rule 42.121(a)(3) states the presumption that only one substitute claim is necessary to replace a challenged claim, and states the presumption may be rebutted by a demonstration of need. *See Idle Free Sys. v. Bergstrom, Inc.*, IPR2012-00027, Paper 26 at 2 (June 11, 2013). Cheetah argues that there is need

for more than one substitute claim because the Board's one-year timeline will not be affected given the structure of the substitution contingencies; it has one opportunity, barring authorization to file an additional motion to amend, "to get it right and there is currently no meaningful guidance as to the metes and bounds of the 'demonstration of need'"; and, it has provided the Board with "key portions of Petitioner's prior art and explanation as to why the art does not read on the substitute claims." Mot. 12–14; PO Reply 2–3.

We agree with BAE that Cheetah has not demonstrated a need for proposing more than one substitute claim for each of claims 1 and 13. *See* Opp. 2–3. Substitute claim 22 is identical to substitute claim 21, except for the additional recital of "wherein the Q-switcher produces an output signal having a pulse width in the range of two (2) nanoseconds to one hundred (100) milliseconds." Mot. 3–4. Cheetah proposes a similar scheme to replace original claim 13. *Id*. at 5–6. Cheetah, however, has not demonstrated the need for proposing narrower substitute claims than the ones we already have considered.

In addition, in order to justify more than one substitute claim for each challenged claim, "a patent owner has to show a special need to justify more than one substitute claim for each challenged claim. In such situations, the patent owner needs to show patentable distinction of the additional substitute claim over all other substitute claims for the same challenged claim." *See Idle Free*, Paper 26 at 5, 8–9. With respect to the new limitation of claims 22 and 25, Cheetah states that "[t]he prior art does not read on the Q-switcher output pulse width because it does not read on the Q-switcher itself." Mot. 12. In its Reply, Cheetah states that "in the manner that the limitations would be read into the claims, the distinction is facially clear without explanation." PO Reply 3. Cheetah's conclusory statements

have not persuaded us of a patentable distinction of substitute claims 22 and 25 over substitute claims 21 and 24, respectively. *See* Opp. 4.

Cheetah also was required to discuss the "significance and usefulness" of the added features in a proposed substitute claim "from the perspective of one with ordinary skill in the art." *See Idle Free*, Paper 26 at 7. This Cheetah failed to do with respect to claims 22 and 25. Therefore, we determine that Cheetah has not met its burden to demonstrate that claims 22 and 25 are patentable.

Patentability of Substitute Claims 23 and 26

Cheetah proposes substituting claim 4 with substitute claim 23 if claims 21 and 4 are both found unpatentable, and substituting claim 15 with substitute claim 26 if claims 24 and 15 are found unpatentable. Mot. 2. Claims 23 and 26 recite the new limitation "and wherein the Q-switcher produces an output signal having a pulse width in the range of two (2) nanoseconds to one hundred (100) milliseconds." *Id*. at 4–7. If Cheetah's motion is granted with respect to substitute claims 23 and 26, substitute claims 23 and 26 would depend from original claims 1 and 13, respectively. Original claims 1 and 13, however, do not recite a Q-switcher. Thus, there would be no antecedent basis for "the Q switcher" recited in claims 23 and 26, and thus, the dependency of those claims is improper. Moreover, as discussed above with respect to substitute claims 22 and 25, Cheetah does not explain why the pulse width of the Q-switcher affects the patentability of substitute claims 23 and 26, or why there is a patentable distinction between substitute claim 23 and substitute claim 21, or between substitute claim 26 and substitute claim 24. *See Idle Free*, Paper 26 at 9–10. We, therefore, determine that

Cheetah has not met its burden to demonstrate that claims 23 and 26 are patentable.[9]

Accordingly, we deny Cheetah's motion to amend.

E. BAE's Motion for Observation

BAE filed a motion for observation regarding Dr. Ippen's testimony on cross-examination. Paper 38. We have considered BAE's observations and Cheetah's responses. *See* Papers 38, 41.

III. ORDER

BAE has demonstrated, by a preponderance of the evidence, that (1) claims 1, 4, 13, 15, 17, and 19 are unpatentable as anticipated by Sanders under 35 U.S.C. § 102(b); and (2) claim 14 is unpatentable as obvious over Sanders under 35 U.S.C. § 103(a).

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 4, 13–15, 17, and 19 of the '673 patent have been shown to be unpatentable; and

FURTHER ORDERED that Cheetah's Motion to Amend is *denied*.

[9] We need not consider any other arguments raised by BAE in its opposition to Cheetah's motion to amend, given that we deny Cheetah's motion for the reasons explained herein.

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